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Report of a Nationwide Survey of Photo-chemical Smog Using the Morning Glory as an Indicator.

[Asagao ni yoru kokagaku sumoggu kansatsu. Zengoku chosa kenkyu hokoku]

by

A Committee for a Nationwide Survey of Photo-chemical Smog, January 1975.

Forward

This survey and research was planned in order to grasp on a large scale the extent of spread across the nation of air pollution (which will be called simply photo-chemical smog) caused by photo-chemical reactions. The plan was to observe the leaves of the morning glory for the appearance of visible damage caused by oxidants and ozone which are secondary products of the photo-chemical reaction. The results of the study showed that injuries caused by oxidants were found on the indicator plants in regions reaching all the way from Miyagi prefecture in the north to Kagoshima prefecture in the south along the Pacific coast,

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Translated for NERC-Library, EPA, from the original Japanese by LEO KANNER ASSOCIATES, P.O. Box 5187, Redwood City, California 94063, (415) 363-3046, October, 1975.

all over Shikoku, and in Niigata and Toyama prefectures along the coast of the Japan Sea. The survey and observations swept away rumors of "phantom smog" which were whispered among some people. Also, through this survey many Junior High School students, who hold the destiny of the next generation, experienced recoginition of photo-chemical smog and the extent to which it causes damage to the plants. We express our appretiation for the fact that initial objectives of the survey and observation were attained by the enthusiastic efforts of everyone involved, even though this is the first time that this kind of survey and research has been performed anywhere on a nationwide scale.

For the smooth execution of the survey and research, the Survey Committee, the Committee of Experts, and the Executive Committee, as listed separately, were organized. We thank each member of the committees, especially each teacher and student member of the Junior High School Executive Committees who participated in the daily observations.

Further, we thank each member of the Committee of Experts and the executive secretaries who provided leadership throughout the period of the survey. We express our appreciation to those who wrote this report by listing their names here. They are Mr. Odaira, Chairman of the Committee of Experts, Mr. Hakucho, a Vice-chairman of the Committee of Experts, and Messrs. Date, Sawada, Iishima, Maeno, Nouchi and Ohashi, Members of the Committee of Experts.

We urge the government to extend this survey and research on "air pollution and damage to plants", making use of the governmental agencies of the nation.

February, 1975

The Forty-five Nationwide Prefectures,

the Metropolis of Tokyo, Hokkaido,

and Yomiuri Newspaper, Inc.

Separate list:

The membership list of the Committee for a Nationwide Survey of Photo-chemical Smog. (No special order) 15 persons

The chairman	Tadayoshi Tasaki	Professor, Faculty of Agriculture, Tokyo University of Agriculture and Industry.
Member	Hitoshi Kasuga	Head of the Air Quality Bureau, Environmental Agency.
"	Iya Yasushima	Head of Elementary and Secondary Education, Ministry of Education.
"	Yoshio Koyama	Secretary General of the Conference on Agriculture and Fishery Technology, Ministry of Agriculture and Forestry.
"	Fumio Endo	Commissioner, the Minister's Secretariat, Ministry of Home Affairs.
"	Ryoichi Ueta	Head, Tokyo Metroplitan Bureau of Environmental Pollution.
"	Akio Iiyama	Head, Osaka Prefecture Office of Environmental Pollution.
"	Nobuo Yamamoto	President, Nationwide Research Society for Junior High School Science Education.
"	Tatsuo Kira	Professor, Faculty of Science, Osaka City University.
"	Masaya Kadota	Associate Professor, Faculty of Agriculture, Nagoya University.
"	Jiro Matsushima	Associate Professor, Faculty of Agriculture, Mie University.
"	Yukihito Tsuno	Professor, Faculty of Agriculture, Tottori University.
"	Yoshiaki Yoneda	Professor, Faculty of Liberal Arts Shizuoka University.
"	Hideo Tachibana	Head, Enterprise Department, Yomiuri Newspaper, Inc.
"	Jitsuo Hasegawa	Managing Editor, Yomiuri Newspaper, Inc.

The membership list of the Committee of Experts. (No special order)

31 persons

The chairman	Toshio Odaira	Director, Air Department, Tokyo Metropolitan Research Institute for Environmental Pollution.
Vice-chairman	Yasuo Ohta	Director, No. 5 Laboratory, National Institute of Agricultural Science, Ministry of Agriculture and Forestry.

Vice-chairman	Koji Hakucho	Director, Environmental Pollution Research Laboratory, Chiba Prefecture Agriculture Experiment Station.
Member	Kozo Niitani	Specialist, Planning Division, Air Quality Bureau, Environmental Agency.
"	Shoichi Matsunaka	Director, Physiology No. 6 Laboratory, National Institute of Agricultural Sciences, Ministry of Agriculture and Forestry.
"	Hiraku Nakamura	Chief Researcher, National Institute of Agricultural Sciences, Ministry of Agriculture and Forestry.
"	Fumio Yamazone	Director, Fertilizer Appraisal Method Laboratory, National Institute of Agricultural Science.
"	Tadashi Sawata	Chief Researcher, Department of Air, Tokyo Metropolitan Research Institute of Environmental Pollution.
"	Tetsuhito Komeji	Researcher, Department of Air, Tokyo Metropolitan Research Institute of Environmental Pollution.
"	Isamu Nouchi	"
"	Takeshi Ohashi	"
"	Noboru Date	Vice-secretary, Tokyo Metropolitan Agricultural Experiment Station.
"	Tsutomu Iishima	Chief Researcher, Tokyo Metropolitan Agricultural Experiment Station.
"	Shigeru Hidariko	Monitoring Section Chief, Osaka Prefecture Environmental Pollution Monitoring Center.
"	Saburo Matsuoka	Head, Department of Educational Extension, Osaka Prefecture Agriculture and Forestry Technology Center.
"	Michio Maeno	Environmental Pollution Survey Section Chief, Department of Technology and Research, Kanagawa Prefecture General Research Institute for Agriculture.
"	Takayuki Suwa	Chief Researcher, Department of Chemistry, Saitama Prefecture Agricultural Experiment Station.
"	Saburo Shibukawa	Chief Researcher, Saitama Prefecture Horiticultural Experiment Station.
"	Ryosaku Endo	Department of Air, Hokkaido Research Institute for Environmental Pollution Prevention.
"	Yuhei Nakasawa	Head, Department of Air, Nagoya Prefecture Research Institute for Hygiene and Environmental Pollution.

Member	Masao Yoshino	Head of Management Department, Oita Prefecture Environmental Pollution Hygiene Center.
"	Yoshio Tachizaki	Vice-president, Tokyo Metropolitan Research Society for Junior High School Science Education
"	Keizo Ogawa	"
"	Kataaki Higashio	President, Osaka Prefecture Research Society for Junior High School Science Education.
"	Tadahiro Ushijima	Associate Professor, Faculty of Agriculture, Tokyo University of Agriculture and Industry.
"	Tatsuo Kira	Professor, Faculty of Science, Osaka City University.
"	Masaya Kadota	Associate Professor, Faculty of Agriculture, Nagoya University.
"	Jiro Matsushima	Associate Professor, Faculty of Agriculture, Mie University.
"	Yukihito Tsuno	Professor, Faculty of Agriculture, Tottori University.
"	Yoshiaki Yoneda	Professor, Faculty of Liberal Arts Shizuoka University.
"	Masami Yanai	Department of Science, Office of Environmental Counter Plan, Okayama Prefecture Agricultural Experiment Station.

Participating schools and the executive committee members of the nationwide photo-chemical survey using the morning glory as an indicator.

0 indicates executive secretary's prefecture. April, 1974

Bloc	Names of prefectures	No.	Participating schools	Teacher in charge (Executive Committee member)	Member of the Executive Committes
Hokkaido-Tohoku Bloc (15 schools)	Hokkaido	1	Nikotoi Junior High, Sapporo City Schools	Noriyoshi Yomogida	Masayoshi Imura Director of Guidance, School Education Section, Hokkaido Agency
		2	Ebetsu City No. 2 Junior High School	Hiroyuki Kawakami	
	Aomori	3	Uramachi Junior High, Aomori City Schools	Yoshiko Tanabe	Yasutaka Hashimoto, Head, Office of Environmental Pollution Investigation
		4	Sanbongi Junior High Towada City Schools	Akio Soma	Fun Sugiyama, Head, No 2 Research and Training Section, Prefectural Education Center
	Iwate	5	Kamitanaka Junior High Morioka City Schools	Takao Chiba	Kentaro Takahashi Deputy Chief, Prefectural Environmental Pollution Center
		6	Kitagami Junior High, Kitagami City Schools	Minoru Chiba	
	Akita	7	Sano Junior High, Akita City Schools	Yasunori Sata	Tadashi Otano, Chief Expert Researcher, Prefectural Environmental Pollution Technology Center
		8	Ohmagari Junior High, Ohmagari City Schools	Akio Kurosawa	
	Yamagata	9	No.6 Junior High, Yamagata City Schools	Naohiko Kudaira	Tohru Takeda Engineer, Environmental Pollution Section, Prefectural Section, Prefectural Department of Hygiene
		10	No.1 Junior High, Sakata City Schools	Yuriko Yamada	
	0 Miyagi	11	Nakayamanaka Junior High Sendai City Schools	Ikuo Toita	Masao Tashiro, Prefectural Department of Environmental Hygiene
		12	Shichigo Junior High Sendai City Schools	Morio Makino	
		13	No.3 Junior High Shiogama City Schools	Ikuko Omachi	Masahiko Oba, Department of Environmental Pollution, Sendai City
	Fukushima	14	Shoryo Junior High Fukushima City Schools	Toshio Sugimori	Masaji Shinouchi, Director, Section of Environmental Pollution Regulations, Department of Prefectural Life Environment
		15	Konahama No.1 Junior High, Iwaki City Schools	Hiroshi Hiruda	

Kanto Bloc (52 schools)

Gunma	16	No.3 Junior High, Maebashi City Schools	Sumio Aoki	Eiji Iwatani, Head, Air Preservation Division, Prefectural Department of Environmental Pollution
	17	Shibugawa Junior High, Shibugawa City Schools	Shigeru Kawanishi	
Tochigi	18	Asahi Junior High, Utsunomiya City Schools	Yoshio Minamiki	Takeshi Tojyo, Division of Air Environmental Pollution
	19	No.2 Junior High Koyama City Schools	Shunpei Nagai	No.2 Section, Prefectural Department of Hygiene and Environment
Ibaragi	20	No. 2 Junior High, Mito City Schools	Hiroshi Kawakami	Yayoe Tominaga Osamu Kobayashi Environmental Pollution Technology Center, Department of Air Preservation, Prefectural Agency for Environment
	21	No. 1 Junior High, Kasumi Town Schools	Hisa Hirasawa	
Saitama	22	Kishi Junior High, Urawa City Schools	Takashi Arai	Masugi Arai, Director Section 2 Department of Air and Noise, Prefectural Environmental Pollution Center
	23	Fujimi Junior High, Kumagaya City Schools	Toshio Kojima	
Chiba	24	Suehiro Junior High, Chiba City Schools	Toshiyoshi Yokoyama	Yashiro Kaneko Chief Air Monitor, Air Preservation Section, Prefectural Department of Environment
	25	Nanso Junior High, Ichihara City Schools	Hiroshi Mori	
	26	Goi Junior High, Ichihara City Schools	Jun Nakajima	
	27	No. 1 Junior High, Ichihara City Schools	Katsuhiro Uchida	Kanichi Ishibashi, Director of Guidance, Guidance Section, Prefectural Board of Education
	28	Sekiyado Junior High Sekiyado Town Schools	Emi Tanno	
	29	Shusei Junior High, Kimitsu City Schools	Yutaka Saito	
	30	Matsuoka Junior High Kimitsu City Schools	Yuzuru Toriumi	
	31	Hikari Junior High, Hikari Town Schools	Masami Ozeki	

Kanto Bloc (52 Schools)	Kanagawa	32	Wada Junior High, Yokohama City Schools	Noboru Aburaya	Shogo Ochiai, Vice-Technical Officer, Department of Air and Noise, Prefectural Agency for Environmental Pollution Counter Plan
		33	Hamatake Junior High, Hiratsuka City Schools	Toshio Kojima	
		34	Kyomachi Junior High, Kawasaki City Schools	Akio Kadoda	
		35	Kunai Junior High, Kawasaki City Schools	Ryuji Aoyagi	
	Tokyo	36	Separately listed (32 schools)		Tadashi Sawata Chief Researcher, No. 8 Laboratory, Department of Air, Metropolitan Research Institute for Environmental Pollution
		68			
Chubu Bloc (18 Schools)	Yamanashi	69	Nishi Junior High, Kofu City Schools	Ichizo Asakawa	Yoshinari Onda Prefectural Department of Environmental Pollution
		70	Yoshida Junior High, Fuji-Yoshida City Schools	Kyoko Okamoto	
	Niigata	71	Higashi Niigata Junior High, Niigata City Schools	Tsuzuku Hasegawa	Shuji Yamashita, Head, Division of Environmental Pollution Regulations, Prefectural Department of Life Environment
		72	Maki Junior High, Maki Town Schools	Mitsuo Watanabe	
	Toyama	73	Ohizumi Junior High, Toyama City Schools	Hideaki Nagai	Yutaka Miyanishi Division of Environmental Management, Prefectural Department of Environment
		74	Kosugi Junior High, Kosugi Town Schools	Hiroshi Kawagishi	
	Gifu	75	Umebayashi Junior High, Gifu City Schools	Yoshiaki Shibata	Mikiyuki Koono, Chief Air Regulations Section, Department of Air Regulations, Prefectural Environment Agency
		76	Minami Junior High, Ohgaki City Schools	Hideo Taneda	
	Nagano	77	Yanagimachi Junior High, Nagano City Schools	Eiji Miyairi	Toshio Muroga, Chief Air Section, Division of Environmental Pollution, Prefectural Department of Life Environment
		78	Shimizu Junior High, Matsumoto City Schools	Hiroshi Yamasaki	

Chubu Bloc (18 Schools)	Ishikawa	79	Shikindai Junior High, Kanazawa City Schools	Takao Shinoda	Teruhisa Dejima, Assistant Head, Division of Regulations Guidance, Prefectural Department of Environment and Environmental Pollution
		80	Yamashiro Junior High, Kaga City Schools	Denkichi Shimono	
	Fukui	81	Myodai Junior High, Fukui City Schools	Yukio Sakai	Shin Yasui, Head, Air Division, Prefectural Environmental Pollution Center
		82	Chuo Junior High, Sabae City Schools	Saichi Saito	
	Aichi	83	Iseyama Junior High Nagoya City Schools	Akira Adachi	Kanae Tsurumi Technical Aid, Division of Air, and Yoshio Nagashima, Engineer, Prefectural Department of Environment
		84	Anjyo Kita Junior High, Anjyo City Schools	Sanae Inagaki	
	Shizuoka	85	Suehiro Junior High, Shizuoka City Schools	Kenji Kawaguchi	Katsuo Koike Head, Prefectural Division of Environmental Pollution
		86	Nishina Junior High, Shizuoka City Schools	Yasuyuki Ujihara	
Kinki Bloc (17 Schools)	Shiga	87	Uchide Junior High, Otsu City Schools	Mutsuo Kawasaki	Kazuhide Yoshikawa, Head, Air and Noise Section, Division of Environmental Pollution Regulation, Prefectural Department of Life Environment
		88	Yasu Junior High, Yasu City Schools	Shinzaemon Okuno	
	Mie	89	Kyonan Junior High, Tsu City Schools	Kazuhiro Nishikawa	Chiaki Shimizu, Air and Noise Division, Prefectural Department of Environment Fumiyuki Saito, Division of Physical Education and Hygiene Prefectural Committee on Noise
		90	Tokiwa Junior High, Yohkaichi City Schools	Sadaki Kiriu	
		91	Shiohama Junior High Yohkaichi City Schools	Fumiko Kitagawa	
	Kyoto	92	Nishinokyo Junior High, Kyoto City Schools	Kanamichi Imamura	Hirozo Koyama, Chief, Air Section, Dicision of Environmental Pollution, Office of Environmental Pollution Counterplan, Prefectural Department of Hygiene
		93	Kitauji Junior High, Uji City Schools	Ken Shimada	
	Nara	94	Tonan Junior High, Nara City Schools	Akira Amano	Toshio Tominaga, Chief, Division of Environmental Pollution, Prefectural Planning Department

Kinki Bloc (17 Schools)	Wakayama	95	Ogura Junior High, Wakayama City Schools	Takeo Shiraishi	Satoshi Nakaba, Chief, Air Section, Division of Environmental Pollution, Prefectural Agency for Life Environment
		96	Kawanishi Junior High, Wakayama City Schools	Hiromichi Kitamoto	
	Hyogo	97	Tarumi Higashi Junior High, Kobe City Schools	Haruo Tanaka	Kookei Takata, Vice-president, Prefectural Research Institute for Environmental Pollution
		98	Miki Junior High, Miki City Schools	Masanobu Fujiwara	
	○ Osaka	99	Yodo Junior High, Osaka City Schools	Yoshio Yoshikawa	Yoshio Nishimura, Chief, Division of Air, Prefectural Department of Life Environment
		100	No. 1 Junior High, Moriguchi City Schools	Masashi Kikuishi	
		101	Shiki Junior High, Hachio City Schools	Takao Kurita	
		102	Nagano Junior High, Kawachi-Nagano City Schools	Takashi Masuda	
		103	Minami Matsuo Junior High, Izumi City Schools	Minoru Terashima	
Chugoku-Shikoku Bloc (20 Schools)	Tottori	104	Nishi Junior High, Tottori City Schools	Mikio Yamashita	Toshihiko Miyata, Chief, Division of Air and Noise, Prefectural Research Institute for Hygiene
		105	Yose Junior High, Yose Town Schools	Hiroko Uehara	
	Shimane	106	No. 4 Junior High, Matsuo City Schools	Takashi Takeda	Hayatami Ohsumi, Chief, Division of Environmental Pollution, Prefectural Department of Environmental Health
		107	No.1 Junior High, Izumo City Schools	Hiroshi Kishi	
	Okayama	108	Fukuhama Junior High, Okayama City Schools	Yukihiko Hikaribatake	Masahiro Kondo, Division of Air Preservation, Prefectural Department of Environment
		109	Fukuta Junior High, Kurashiki City Schools	Kenji Watanabe	
	○ Hiroshima	110	Kokutaiji Junior High, Hiroshima City Schools	Minoru Yoneda	Yukitatsu Ohmoto, Head, Department of Air and Noise, Research Institute for Environmental Pollution affiliated with Prefectural Research Institute for Hygiene
		111	Itsukaichi Junior High, Itsukaichi Town Schools	Yuji Funamoto	

Chugoku-Shikoku Bloc (20 Schools)	Yamaguchi	112	Kuwayama Junior High, Bofu City Schools	Yoji Fujii	Yutaka Mizunuma, Dvision of Environmental Pollution, Environmental Pollution Agency, Prefectural Department of Hygiene
		113	Yuda Junior High, Yamaguchi City Schools	Kunihiko Yamanoi	
	Kagawa	114	Jyonai Junior High, Takamatsu City Schools	Teruhiro Ohyama	Tetsuya Noda, Office of Counter Plan Against Environmental Pollution, Prefectural Department of Life Environment
		115	Sakaide Junior High, Sakaide City Schools	Hajime Higuchi	
	Tokushima	116	Tokushima Junior High, Tokushima City Schools	Akio Bando	Kimio Takeda, Air Section, Division of Environmental Pollution, Prefectural Department of Life Environment
		117	Anan Junior High, Anan City Schools	Masayuki Nakagawa	
	Kochi	118	Shioe Junior High, Kochi City Schools	Kazuko Miyamoto	Akihiko Wakishi, Chief, Air Section, Division of Environmental Pollution, Prefectural Environmental Preservation Agency
		119	Hokuryo Junior High, Nangoku City Schools	Tadashi Kimura	
	Ehime	120	Naiguu Junior High, Matsuyama City Schools	Atsumasa Miyamoto	Nobuo Nakai, Prefectural Department of Life Environment
		121	Kita Junior High, Ohsu City Schools	Akio Mori	Koji Hata, Division of Environmental Pollution, Shinguhama City Department of Environment
		122	Kita Junior High, Shinguhama City Schools	Isao Hashimoto	
		123	Nakahagi Junior High, Shinguhama City Schools	Masue Kamino	
Kyushu-Okinawa Bloc (18 Schools)	Fukuoka	124	Kashii No. 2 Junior High, Fukuoka City Schools	Sumio Mizushiro	Takashi Suga, Division for Protection of Nature, Environmental Service Agency, Prefectural Department of Hygiene Atsuko Murata, Division of Life Environment, Prefectural Hygiene and Environmental Pollution Center
		125	Kumanishi Junior High, Kitakushu City Schools	Naoya Endo	

Kyushu-Okinawa Bloc (18 Schools)

Saga	126	Jyoto Junior High, Saga City Schools	Yoshiyuki Kitamura	Masakazu Tanaka Division of Environmental Pollution, Prefectural Agency for Preservation of Environment
	127	Kiri Junior High, Tosu City Schools	Kimiyuki Mohri	
Nagasaki	128	Baikosaki Junior High Nagasaki City Schools	Tsunenobu Suginaga	Makoto Yamaguchi, Assistant Head, Division of Environmental Preservation, Prefectural Department of Environment
	129	Asahi Junior High, Sasebo City Schools	Nobuyoshi Manabe	
	130	Isahaya Junior High, Isahaya City Schools	Akira Sato	
Ohita	131	Jyoto Junior High, Ohita City Schools	Yasuo Abe	Masao Yoshino, Principal Administrative Officer, Prefectural Environmental Pollution Center
	132	Daizai Junior High, Ohita City Schools	Mitsuo Okamura	
Miyazaki	133	Nishi Junior High, Miyazaki City Schools	Ikuo Kiyo	Harutomo Tokuguchi, Assistant Head, Prefectural Division of Environemtal Pollution Kazumitsu Nagatomo, Engineer, Air Preservation Section, Division of Environmental Pollution, Prefectural Department of Environmental Health
	134	Himeshiro Junior High, Miyakonojyo City Schools	Tetsuya Kusumure	
	135	Fukushima Junior High, Kushima City Schools	Shiro Fukushima	
Kagoshima	136	Ishiki Junior High, Kagoshima City Schools	Masao Makise	Yoshihiro Tokumochi, Division of Environmental Pollution Regulations, Prefectural Agency for Environment
	137	Kawanouchi Kita Junior Kawanouchi City Schools	Sadao Ohrokuno	
Kumamoto	138	Demizu Junior High, Kumamoto City Schools	Norio Nakajima	Yohichi Hanayoshi, Guidance Director, Guidance Office, Prefectural Board of Education
	139	Matsubashi Junior High, Matsubashi Town Schools	Kiyoshi Yoshizaki	
Okinawa	140	Koroku Junior High, Nawa City Schools	Tsutomu Nakanishi	Seiichi Ohshiro, Prefectural Guidance Director
	141	Ishikawa Junior High, Ishikawa City Schools	Masatada Takaesu	

Participating Schools in Metropolitan Tokyo (32 Schools)

Name of Ward City or County	No.	Participating School	Instructor In Charge
Edogawa Ward	36	Mizue No.2 Junior High School	Hidesumi Kawamoto
"	37	Mizue Junior High School	Akira Shishige
Shikama Ward	38	Horikiri Junior High School	Minoru Nakamura
Taito Ward	39	Taito Junior High School	Hidetsugu Takagi
Ohta Ward	40	Kojigaya Junior High School	Noriyuki Nakazima
Koto Ward	41	No.2 Ohshima Junior High School	Toshiaki Hasegawa
Shinjyuku Ward	42	Higashi Toyama Junior High School	Kohei Sekiguchi
Shinagawa Ward	43	Chihara No.3 Junior High School	Jyunichi Mamiya
Itabashi Ward	44	Akatsuka No.2 Junior High School	Shohachi Matsui
Minato Ward	45	Minarimon Junior High School	Kazuo Hoshino
Sumida Ward	46	Azu No.2 Junior High School	Takaya Yamamoto
Renma Ward	47	Kami Ishikami Junior High School	Kasumi Imura
Mitaka City	48	Mitaka No.3 Junior High School	Seiji Sato
Higashi Kurume City	49	Kurume Junior High School	Yuji Yashima
Koganei City	50	Midori Junior High School	Kazuto Shimura
Higashi Murayama City	51	No.2 Junior High School	Yasuo Sanada
Tama City	52	Nagayama Junior High School	Noboru Shinozaki
Machida City	53	Tsurukawa Junior High School	Chuzo Tsukada
"	54	Tadau Junior High School	Yasuya Yamashiro
Hachiohji City	55	No.5 Junior High School	Morihiko Yoshida
"	56	No.4 Junior High School	Hiromasa Harashima
"	57	Yokoyama Junior High School	Shigeyuki Genhara
"	58	Omokata Junior High School	Saburo Kawamoto
"	59	No.1 Junior High School	Kyoko OOhgushi
"	60	Kiyoizumi Junior High School	Kuniharu Uenoyama
Aoume City	61	No.6 Junior High School	Jyunichi Utsuki
"	62	No.2 Junior High School	Yomio Tanokura
Nishi Tama County	63	Zuiho Junior High School	Atsumoto Kikuchi
Nishi Tama County	64	Itsukaichi Junior High School	Tsutomu Takahashi
Nishi Tama County	65	Higawa Junior High School	Sadao Harashima
Nishi Tama County	66	Okawanouchi Junior High School	Kenshiro Kobayashi
Ohshima Town	67	No.2 Junior High School	Takehisa Sugiyama

Translator's Note: Please note that there are several ways to pronounce individual names, and the tranliteration used here may not be the one used by the individual.

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References

Attatched Materials (separate volume)

Appendix 1. Relative locations of the participating schools and the Ox measuring centers.

" 2. Classified table of the degree of damage found by the simultaneous survey made in July.

" 3. Classified table of the degree of damage found by the survey made in August.

" 4. Classified table of the midway simultaneous survey prepared by the Committee of Experts.

" 5. Concentration level of Ox, SO_2 and NO_2 in July. (Value for an 8 hour period between 9:00 A.M. and 4:00 P.M.)*

" 6. The average value of the highest daytime temperature and the volume of precipitation during July.

" 7. The surface weather maps of the days in which photo-chemical oxidant warnings were issued over reletively large areas during July and August.

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*Translator's Note: sic.

Introduction

This survey and research was sponsored by all 45 prefectures of Japan, the Metropolis of Tokyo, Hokkaido and the Yomiuri Newspaper Inc., as the nucleus for execution with the extensive cooperation of the Nationwide Research Society for Junior High School Science Education and with assistance from the Environmental Agency, Ministry of Education, Ministry of Agriculture and Forestry and Ministry of Home Affairs.

The objectives of this survey and research can be summarized as follows:

The main secondary products of photo-chemical reactions are:

a. As oxidizing agents (oxidants):

ozone, nitrogen dioxide, organic peroxide nitrates (PANs)

b. As reducing agents:

aldehydes, such as formaldehyde, benzaldehyde, acrolein.

c. As particulate substances:

sulfuric acid mist, nitric acid mist, and other aerosols.

It requires special analytical apparatus,cooperative work by highly trained analysts, and a large sum of money to determine the concentration of these pollutants. It is a well known fact that it is possible to use oxidants as an indicator for the secondary pollutants produced by photo-chemical reactions.Accordingly, it is possible to know the extent of photo-chemical smog by observing the symptoms of damage caused by oxidants through the use of an oxidant indicator plant (morning glory, kidney bean, Japanese radish, taro, spinich and turnip) which can be very sensitive to the damage caused by oxidants.

Visible symptoms appearing on the leaves of these plants can be distinguished from other damage caused by disease or insects by anyone who is trained to make these observations. Therefore, the following results can be expected from observations which can be made by junior high school students, directed by teachers, of damage caused by oxidants on an indicator plant, such as the morning glory.

1. Usefulness in determining whether photo-chemical smog has appeared in each area or not.

2. Confirmation of the reality of damage by photo-chemical smog by visible effects on the plants.

3. There is a possibility, in the future, of using the results of these observations as material for establishing environmental standards for oxidants related to the life environment.

4. Junior high school students, who bear the destiny of the next generation, learn through personal experience the necessity of preventing air pollution.

5. Local governments which have not been able to determine whether photo-chemical smog exists or not can establish criteria by making use of this kind of survey using indicator plants.

6. In the areas where damage by oxidants appears on the indicator plants, the information will be usefuul in the future in preparing monitoring systems for secondary pollutants, such as nitrogen oxides, hydrocarbons, etc..

7. Depending on the results of further analyses, investigation of the damage due to oxidants by using indicator plants may be useful in finding areas with a good air environment.

1. Organization of the Survey.

In executing this survey, the Nationwide Survey Committee was estalished to decide the basic plan for the enterprise. As a support organization for the Nationwide Survey Committee, a Committee of Experts, made up of scholars and experts in the field, was established.

The model of this survey and research organization follows. The responsibility of each committee member is shown in Table 1.

Table 1. Classified table of the responsibility shared for the nationwide survey of the observation of photo-chemical smog using the morning glory as an indicator.

Nationwide Survey Committee on Photo-chemical smog.

	C 委員	f 専門委員会		M 幹事県（幹事）	P 都道府県実行委員	S 調査校実行委員
		g 全体委員会	j 小委員会			
a 構成	1.国，都道府県など関係機関の長 2.学識者 d	1.学識者 2.国，自治体および中学校理科教育研究会の関係職員 h	関係する事項別に専門委員長が決定する K	○北海道・東北ブロック（宮城県） n ○関東ブロック（東京都） ○中部ブロック（愛知県） ○近畿ブロック（大阪府） ○中国・四国ブロック（広島県） ○九州・沖縄ブロック（福岡県） 幹事は各幹事県の担当者	各自治体の環境（又は公害）関係あるいは教育関係の職員 q	各調査校の担当教諭 t
b 幹事の役割	1.事業の基本計画の決定 2.事業の実施方法の検討 3.調査結果の検討と公表 e	全国調査の集計解析を行いその結果を委員会に報告する i	1.調査計画の技術面の企画立案をはかる．すなわち，自然現象である日光，前駆，発生，伸長，汚染，共用の各項目 2.都道府県実行委員，調査校実行委員における技術的指導 l	ブロックの専門委員（兼務）と協議のうえ，ブロック会の開催，ブロック内のとりまとめなどの業務を統括する o	1.担当都道府県の調査事業の統括 r 2. 担当都道府県内のデータを調査校実行委員と共同でとりまとめる 3. ブロック内の調査結果の集計，解析をブロック内の専門委員，ブロック幹事と共同で行う	1.調査担当者（学校）の指導 u 2. 調査日誌，記録，写真などの取りまとめ 3.都道府県実行委員と共同で，調査校の調査観測結果の検討と集計を行う

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Table 1. continued.

Key: a. Composition
b. Main duties.
c. Committee member.
d. 1. Heads of related agencies of national and prefectural governments.
2. Scholars and experts.
e. 1. Make decisions on the basic plan of the enterprise.
2. Study the methods of implementation of the enterprise.
3. Study and announce the results of the survey.
f. Members of the Committee of Experts.
g. General Committee
h. 1. Scholars and experts.
2. Related staff members of the national and local governments and the Research Society for Junior High School Science Education.
i. Compute and analyze the nationwide survey and report the results to the committee.
j. Subcommittee.
k. Chosen individually for each field by the Chairman of the Committee of Experts.
l. 1. Make plans for technical side of the survey.
Chairman Odaira, Vice Chairmen Ohta and Hakucho.
Committee members, Maeno, Iishima, Date and Sawata
2. Provide technical leadership to the members of the Executive Committees of the prefectures and the members of the Executive Committees in participating schools.
m. Subdivision and designated prefecture of Executive Secretary.
n. Hokkaido-Tohoku Bloc (Miyagi prefecture)
Kanto Bloc (Metropolis of Tokyo)
Chubu Bloc (Aichi prefecture)
Kinki Bloc (Osaka prefecture)
Chugoku-Shikoku Bloc (Hiroshima prefecture)
Kyushu-Okinawa Bloc (Fukuoka prefecture)
The Executive Secretary is the member of the Executive Committee from the prefecture in parenthesis.
o. Consulting with the members of the Committee of Experts (Separate Table) for the bloc concerned, oversee the business of making arrangements for bloc meetings and other arrangements within the bloc.
p. Prefectural Executive Committee Member.
q. Staff members of each local government related to education.
r. 1. Supervise the survey work for the specific prefecuture.
2. With the Executive Committee Members of the participating schools, arrange the data collected in the specific prefecture.
3. Jointly with the Members of the Committee in the bloc concerned and the Executive Secretary of the bloc, compute and analyse the results of the survey in the bloc.
s. Member of the Executive Committee from the participating schools.

Table 1. continued.

Key: t. Instructor who is in charge of the survey at each participating school.

u. 1. Provide leadership for the persons making the survey (students).
2. Arrange the diary of the survey, records and photographs.
3. Jointly with the members of the Executive Committee in the prefecture, make studies and tabulate the results of the observations made at the participating schools.

Model of the Organizational system.

Key: a. Model of the organizational system.
b. Nationwide Survey Committee.
c. Give instructions for the observation and survey.
d. Committee Members of the Executive Committee of the Executive Secretary's prefecture.
e. Members of the Executive Committees of prefectures.
f. Reports of the results of observations.
g. Members of Junior High School Executive Committee, Junior High School club members.
h. Analysis of the results of the observation and survey.
i. Committee of Experts.
j. Give assistance by providing expert knowledge and technique.

2. The Schools Participating in the Survey.

As shown in Fig. 1, 140 public junior high schools scattered throughout Japan participated in the survey. The distribution of the schools covers all of Japan, from Hokkaido in the north to Okinawa prefecture in the south.

Basically, two schools were chosen from each prefecture, but more than two schools were chosen in Tokyo Metropolis (32 schools), Chiba prefecture (8 schools), Osaka prefecture (5 schools), Kanagawa prefecture (4 schools), Miyagi, Mie, Nagasaki and Miyazaki prefectures (3 schools in each).

3. The Plant Variety used for the Survey and Study and Training Conference Preceeding the Start of the Survey.

The Scarlet O'Hara variety of morning glory, which was studied at the Tokyo Metropolitan Research Institute of Environmental Pollution in 1972 - 1973 and is considered to be most suitable for this kind of survey, was used.

Because in general the morning glory is easy to grow and new leaves open up continuously as the vines grow, it has the advantage of long use as an indicator plant because it is highly sensitive to oxidants, showing symptoms of damage at an integral value* (Ox dose 9 - 16 o'clock) for the concentration of oxidant and length of time around 50~60 pphm·hr, and the symptoms are clear and easy to detect.

On April 27, 1974, a Study and Training Conference was held for the members of the executive committees of the prefectures and junior high schools. The conference dealt with air pollution caused by photo-chemical

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*The integral value or "Ox dose" is the cumulative average hourly value of the Ox concentration beginning at 8:00 A.M. and ending at 4:00 P.M.. It is expressed in pphm·hr units; pphm means $\frac{1}{100,000,000}$.

Fig. 1. Distribution map of the participating schools (school no.)

Key: a. Enlarged map of Tokyo Metropolis. b. Okinawa prefecture.

reactions, case examples, and the main points of the observation and survey.

In June, 1974, Study and Training Conferences were held again in the Kinki Bloc, the Kyushu Bloc and Chiba prefecture. During the period of the survey bloc meetings were called, as needed, by the secretary-general of the bloc where the period of the survey and other aggangements were discussed.

4. Period of the Survey and the Methods Used for the Survey.

Prior to seeding, the soil of the land planned to be used for seeding at each participating school was tested and an area having soil with the correct pH (pH around 6.5) was selected.

A one month period, July, 1974 was designated as the survey period on a nationwide scale. Basically, every day between 9:00 A.M. and 10:00 A.M. the prescribed items were filled in on the "Diary of survey of damage to the morning glory" (Table 2) and" ketch of the damaged leaves" (Figure 2).

When visible damage was seen, the leaf with the largest amount of damage was photographed two days after the discovery (for example, if the damage was discovered on July 5, it was photographed on July 7).

The height of the plants and the number of leaves was surveyed on every Monday, and the entire area of the planting was photographed once every two weeks, even when no damage was discovered.

In other months, the survey was left up to each prefecture. The prefectures were asked to report as much of the data collected as possible to the Nationwide Survey Committee.

Using the forms shown in Table 3 and Table 4, the data on the hourly average value of Ox, SO_2, NO_2, the day's weather, the amount of precipitation and the day's highest temperature were collected from each local

Table 2. Diary of Survey of Damage to the Morning Glory.

Committee for a Nationwide Survey of Photo-chemical Smog.

a 道府県名	都道府県	b 学校名	中学校 調査名	通し No.

c 植付場所の環境条件 e　　f 栽培方法 g 播種 月 日, 移植 月 日

h 調査月日	調査株	i 最大被害葉の被害面積	k 丈	l 分枝数	m 被害葉数	o 葉の 表裏	p 葉の 被害位置	q 葉の 色	r 葉の 大きさ	s 症状	t 土壌水分	u 撮影 No.	z 特記事項
	A	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
月 日	B	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
	A	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
月 日	B	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
	A	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
月 日	B	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
	A	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
月 日	B	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
	A	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
月 日	B	0 1 2 3				表 裏	A B C	A B	小 中 大	白 褐 黄白 その他 ( )	乾 普 湿		
		oo	pp	qq	ss	tt	uu	vv	ww	xx	yy		zz
欠株 mm		0：なし 1：被害程の10%以内 2：10~30% 3：30%以上	地面からつるの頂上まで	調査しているつるの全節数	調査つるの被害節数	被害葉を部分的 表 裏のみ 表 裏に対し %	A 葉のみ B 茎頂部 C 茎中部	A 緑白斑タイプの被害 B：ネクロシス 両方ともあるときは両方に○印	小 1mm以下 中 1~5mm 大 5mm以上	白：白色 褐：褐色 黄色 黄白色 その他（ ）色	乾：葉がふくとほこりがたつ 普：葉のふった直後の状態 湿：中間		被害葉のスケッチ 記録写真撮影枚の別 その他気のついた事項

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Table 2. continued.

Key: a. Name of prefecture.
b. Name of the school participating in survey.
c. Surveyor
d. Serial number
e. Environmental condition of the planting location.
f. Method of cultivation.
g. Date of seeding.Date of transplantation.
h. Month and date of survey.
i. The plant surveyed.
j. The damaged area of the leaf with the greatest damage.
k. Height of the plant.
l. The total number of leaves.
m. The number of damaged leaves.
o. Symptoms of damage to the leaves.
p. Front only.
q. Extended to the back.
r. Location of the damage.
s. Bleached spot.
t. Necrosis
v. Size of the spot.
w. Color of the spot.
x. Moisture in the soil.
y. Photograph No.
z. Items specially noted.
aa. front
bb. back
cc. small
dd. medium
ee. large
ff. white
gg. brownish
hh. yellow white
ii. other
jj. dry
kk. normal
ll. wet
mm. Explanation
oo. 0: none. 1: less than 10% of the area of the leaf.
2: 10 - 30% 3: over 30%
pp. From the ground to the top of the vine.
qq. Total number of leaves on the vine being surveyed.
rr. Surveyed only on Mondays.
ss. Number of damaged leaves on the vine being surveyed.
tt. Damage appearing on aa: front only, bb: extending to the back.
uu. A along the edge of the leaf.
B between the lines of the leaves.
C all over the leaf.

Table 2. continued.

Key: vv. A: damage of the bleached spot type.
B: necrosis
o indicates both A and B.
ww. cc: below 1 mm dd: 1 - 5 mm ee: over 5 mm
xx. ff: white gg: brownish hh: yellow white ii: other color
yy. jj: Dust rises when wind blows. ll: Condition immediately after a rain.
kk: mid rain *
zz. Sketch of the damaged leaves. Photograph for the record.
Other items noticed.

Fig. 2 Sketch of the damaged leaves.

Key: a. Location of the true leaves (from the bottom).
b. The day damage appeared.
c. The day the leaf was dropped.
d. Survey plant A.
e. Survey plant B.
f. Items specially noted.

Table 3. Environmental Data Collection Form.

Key: a. Prefecture
b. Location of the place measurement was taken.
c. Name of the pollutant.
d. Circle the corresponding pollutant.
e. July 1 - 31, 1974, August 1 - 31, 1974.
f. Unit
g. Time
h. Date
i. Average
j. Highest
k. Lowest

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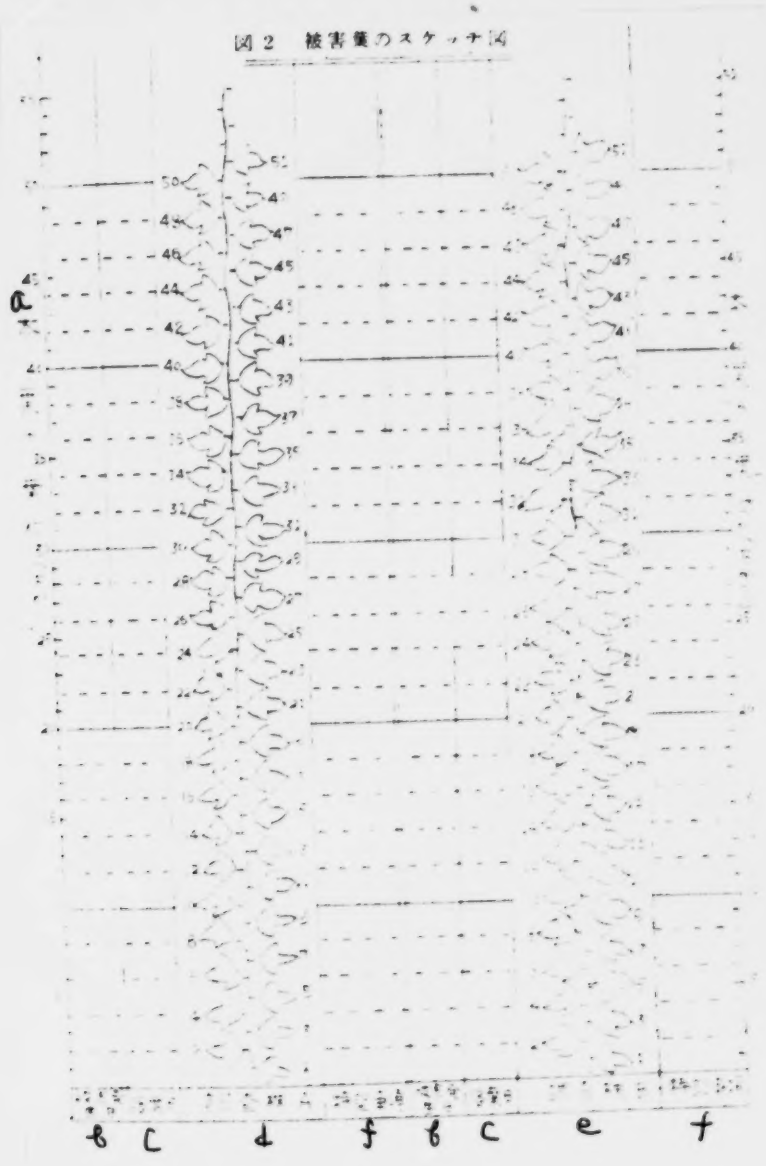
*Translator's Note: sic.

Fig. 2 Sketch of the damaged leaves.



Key on page 29.

Table 3. Environmental Data Collection Form.

表3　環境データ集計様式　a 都府 道県　b 測定所

c 汚染物質名　NO_2　NO　SO_2　Ox　d（該当物質を○で囲むこと）　f（単位 PPHM）

e（1974年7月1日～31日，8月1日～31日）

時 g ＼ h 日	1	2	3	4	5	6	7	8	9	…	20	21	22	23	24	25	26	27	28	29	30	31	計	i 平均	j 最高	k 最低
1																										
2																										
3																										
4																										
5																										
6																										
7																										
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21																										
22																										
23																										
24																										
計																										
i 平均																										
j 最高																										
k 最低																										

Key on page 29.

Table 4. Weather

項目 b ＼ 日 a	1	2	3	4	5	6	7	8	9	…	21	22	23	24	25	26	27	28	29	30	31	g 計	h 平均
c 天候(晴曇雨)																							
降 d 水量																							
e 当日の最高気温																							
f 最多風向																							

i ○気象データは，各県気象官所のデータを記入して下さい。気象官所のない場合は，県所有の気象のデータ（例：大気のモニタリングスティシ
■ンとか，当該学校のもの）を使用して下さい。

Key: a. data
b. item
c. weather (clear, cloudy, rain)
d. The amount of precipitation.
e. The highest temperature of the day.
f. Direction of the strongest wind.
g. total
h. average

i. Please enter the weather from the official weather bureau of each prefecture. When the official weather bureau of the prefecture does not exist, use the data possessed by the prefecture (for example, data from the air monitoring station or from the school concerned).

5. State of Official Announcement of the Emergency Measures (Warnings) Concerning Photo-Chemical Oxidants in the Country.

Table 5 shows the variation in the number of warnings issued by each local government which issued warnings in accordance with the emergency measures of Article 23 Section 1 of the Law for the Prevention of Air Pollution (when the one hour average value of the concentration of oxidant is above 0.15 ppm*, and when the pollution condition is expected to continue, judging from the weather conditions - from now on it will be referred to as an oxidant warning).

Twenty-two prefectures issued warnings in 1974. Among these, the first warnings ever to be issued in Yamaguchi prefecture and Tokushima prefecture were issued in 1974. Miyagi prefecture issued warnings in 1973 but none was issued in 1974. A month by month comparison shows that in July 1974 photo-chemical smog warnings were issued only 28 times in the nation, 98 times less than in July 1973. This was due to the fact that July 1974 was still a part of the rainy season nationwide.

The Emergency Measure (one hour average value of the concentration of oxidant greater than 0.5 ppm and the pollution expected to continue, judging from the weather conditions - from here on it will be referred to as a Serious Emergency Warning) as provided for in Article 23 Section 4 of the Law for Prevention of Air Pollution has never been issued.

Each prefecture has established an alarm system operating between the warning and serious emergency warning levels. It is issued when a one hour average value of the concentration of oxidant is above 0.3 ppm (above 0.25 ppm in Gunma prefecture and Saitama prefecture).

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* ppm is a unit defined as $\frac{1}{1,000,000}$.

Table 5. Changes in the number of photo-chemical oxidant warnings issued.

都府県名 ＼ 年	1970	1971	1972	1973	1974	1974年のオキシダント0.3 ppm/hr 以上出現日
宮 b 城				3		
茨 C 城				16	21	14	
栃 d 木					10	10	
群 e 馬					1	4	
埼 f 玉			23	15	45	29	上尾8/6 0.30ppm
千 g 葉			19	21	28	26	船橋5/18 0.33ppm
東 h 京	7		33	33	45	26	調布5/18 0.32ppm
神 i 奈 川			11	31	30	26	高津8/3 0.32ppm
静 j 岡					8	15	
愛 K 知			1	5	8	2	
三 l 重				4	6	7	
滋 m 賀					4	4	
京 n 都				7	17	17	
大 o 阪			4	18	26	27	高石5/17 0.3ppm
兵 p 庫			7	19	23	19	
奈 q 良				1	6	3	
和 r 歌 山				1	1	1	
岡 s 山				3	14	16	笠岡7/13 0.34ppm
広 t 島					9	18	
山 u 口						5	
徳 v 島						2	
香 w 川					1	4	
愛 X 媛				2	22	13	
合 y 計	7	98	176	328	288	

Note: (1) Above 0.3 pphm/hr of Ox appeared in the following places in 1973: Kanagawa prefecture (Yokosuka 4/11 0.3), Saitama prefecture (Wako 7/13 0.3), Osaka prefecture (Kawachi-Nagano 8/10 0.31, Neyagawa 8/11 0.3).
(2) There are prefectures which have not establised a warning system. It is expected that there were areas where Ox levels were above 0.15 ppm/hr even if the warnings do not appear in this table.

Table 5. continued.

Key: a. Name of prefecture.
b. Miyagi
c. Ibaragi
d. Tochigi
e. Gunma
f. Saitama
g. Chiba
h. Tokyo
i. Kanagawa
j. Shizuoka
k. Aichi
l. Mie
m. Shiga
n. Kyoto
o. Osaka
p. Hyogo
q. Nara
r. Wakayama
s. Okayama
t. Hiroshima
u. Yamaguchi
v. Tokushima
w. Kagawa
x. Ehime
y. Total
z. Year
aa. Days in which over 0.3 ppm/hr of oxidant appeared in 1974.
bb. Ueo 8/6 0.30 ppm
cc. Funabashi 5/18 0.33 ppm
dd. Chofu 5/18 0.32 ppm
ee. Takatsu 8/3 0.32 ppm
ff. Takaishi 5/17 0.3 ppm
gg. Kasaoka 6/13 0.34 ppm

Fig. 3. Distribution of the number of photo-chemical oxidant warnings issued (1974).

Key: a. Okinawa prefecture.
b. No warning issued.
c. Warnings issued 1 -9 times.
d. Warnings issued over 10 times.
e. The number indicates the number of warning issued.

Fig. 3. Distribution of the number of photo-chemical oxidant warnings issued (1974).

Key on page 35.

In 1974, 14,725 persons reported harmful effects of oxidants on health. This is the smallest number since 1970 (1970 - 17,887 persons, 1971 - 48,118 persons, 1972 - 21,245 persons, 1973 - 31,966 persons). As can be seen in Table 6, no proportionality is seen between the number of warnings issued and the number of people reporting harm. It can not be concluded that the concentrations of nitrogen oxide and hydrocarbons which generate photo-chemical oxidants have decreased because the numbers of warnings decreased. The photo-chemical reaction is greatly influenced by weather conditions, including the altitude of temperature inversions, the amount of sunshine, wind velocity and temperature.

For reference, a distribution of the prefectures which issued warnings during April - October, 1974 is shown in Fig. 3. As can be seen in the Figure, the appearance of oxidant concentrations above 0.15 ppm/hr is concentrated along the Pacific coast.

6. A Summary of the Concentration of Ox, SO_2 and NO_2 in the Country in July, 1974.

This survey was made by comparing damage to the morning glory and the concentration of each pollutant, i.e., the measured value during an eight hour period, 9:00 A.M. - 4:00 P.M., of the concentration of each pollutant. (The value for 9 o'clock was the one hour average value from 8 - 9; the same procedure was followed to 4 P.M..)

1) State of oxidant (Ox) pollution.

Table 7 shows a summary of the degree of pollution. The summary was prepared by using the measured value for Ox taken at measuring centers (94 measuring centers) relatively close to the schools participating in

Table 6. Month by month chart of the number of photo-chemical oxidant warnings issued and the number of persons reporting effects on health. (Part 1)

a 回数・人員 / 都府県名	4 b 月		5 c 月		6 d 月		7 e 月		8 f 月		9 g 月	
	h 回数	i 届出人数	h 回数	i 届出人数	h 回数	i 届出人数	h 回数	i 届出人数	h 回数	i 届出人数	h 回数	i 届出人数
宮 b 城												
茨 C 城			3	15	1		3		5	2	2	
栃 d 木	2	9	4	6	2	23	1		1			
群 e 馬			3		1							
埼 f 玉			6	869	6	30	6	493	9	105	2	1
千 g 葉	2	1	6	233	5		4	1	5	1	3	1
東 h 京	3	17	5	1.745	6	63	2	816	9	49		12
神 奈 川	2	50	4	479	4	15	1	8	11	150	2	
静 j 岡			1		6	162			7		1	
愛 K 知				69	1	9		58	1	8		7
三 l 重			1	380	3	143		30	3	1		
滋 m 賀					3							
京 n 都		1	5		5							
大 o 阪	1		2	522	10	185	2	17	9	44	1	
兵 p 庫			2	4.126	5	233	1		5	14	4	
奈 q 良					1				2			
和 r 歌 山									1			7
岡 S 山	1		3	140	8	365	1	18	2		1	
広 t 島			4	1.517	6	688	2	36	5	5	1	414
山 u 口			1				1		3			
徳 v 島							1					
香 w 川					2				2			
愛 x 媛			2		6		3	2	2			
合 y 計	11	78	52	10101	81	1.916	28	1.479	90	379	17	442

Note: Among the 328 warnings issued in 1973, 81% were issued in June, July and August (31 times in June, 126 times in July and 108 times in August).

Table 6. (Part 2)

1974年

a 10月		b 11月		発令回数 e	届出人員 f	g 初発日	h 発令終日
c 回数	d 届出人数	c 回数	d 届出人数	計	計		
					0		
				14	17	5 18	9 7
				10	38	4 18	8 24
				4	0	5 19	6 16
				29	1,498	5 17	9 6
1				26	237	4 12	10 26
1	9			26	2,711	4 11	10 4
2	239			26	941	4 12	10 26
				15	162	5 18	9 20
				2	151	6 16	8 3
	72		4	7	630	5 18	8 6
				4	0	6 9	8 6
				17	1	5 3	8 13
2	6			27	774	4 13	10 26
2				19	4,373	5 17	10 26
				3	0	6 9	8 22
				1	7	8 10	
				16	523	4 24	9 5
				18	2,660	5 7	9 5
				5	0	5 17	8 23
1				2	0	7 24	10 26
				4	0	6 12	8 21
				13	2	5 17	8 20
9	326	0	4	288	14,725	4 11	10 26

Note: Among the 288 warnings issued in 1974, 69 % were issued in June, July and August (81 times in June, 28 times in July and 89 times in August).

Table 6. (Part 1) continued.

Key: a. Name of prefecture.
b. Miyagi
c. Ibaragi
d. Tochigi
e. Gunma
f. Saitama
g. Chiba
h. Tokyo
i. Kanagawa
j. Shizuoka
k. Aichi
l. Mie
m. Shiga
n. Kyoto
o. Osaka
p. Hyogo
q. Nara
r. Wakayama
s. Okayama
t. Hiroshima
u. Yamaguchi
v. Tokushima
w. Kagawa
x. Ehime
y. Total
z. Frequency, number of people.
aa. Month
bb. April
cc. May
dd. June
ee. July
ff. August
hh. Frequency
ii. Number of people reporting.

Table 6. (Part 2) continued.

Key: a. October
b. November
c. Frequency
d. Number of persons reporting.
e. Total number of warnings issued.
f. Total number of people reporting.
g. The date on which the first warning was issued.
h. The date on which the last warning was issued.

Fig. 4.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory notes.
d. The number of days in which the day's highest concentration of Ox was above 10 pphm or the day's Ox dose (9:00 A.M. - 4:00 P.M.) was over 50 pphm·hr.
X indicates none
O below four days
● over five days
- lacks measurement
( ) no measurement was taken for more than 4 days.
Note: Mobile measurement center was used in Kumamoto only.

Fig. 4. Prevalence in the individual area of days in which highly concentrated Ox appeared (July, 1974).

図1　高濃度OX出現日数の地域別頻向　（1971年7月）

Key on page 40.

the survey.

An Ox concentration above 10/pphm·hr or an Ox dose greater than 50 pphm hr during 9:00 A.M. - 4:00 P.M. appeared at 60 out of a total of 94 measuring centers (2 mobile measuring centers included). Their distribution is shown in Fig. 4.

They are spread over a wide area including Miyagi prefecture, Niigata prefecture, all the prefectures in the Kanto area, along the coast of Ise Bay and Osaka Bay and the prefectures adjoining them, along the Seto Inland Sea coasts and Ohita prefecture.

It should be noted that the photo-chemical reaction is beginning to be seen in Niigata prefecture, Ishikawa prefecture and Fukui prefecture along the coast of the Japan Sea.

When the degree of Ox pollution is looked at in detail in Fig. 4 and Fig. 5, it can be seen that the concentration of pollution is relatively high around Tokyo Metropolis and along the coasts of Ise Bay and Osaka Bay, compared to other areas. The figures also show that the locations with the day's highest value or the highest daily dose (9:00 A.M. to 4:00 P.M.), 15 pphm·hr respectively, were concentrated in these areas.

Only in the Tohoku-Hokkaido Bloc did highly concentrated Ox pollution first appear in the last part of July; in the other five blocs, it appeared sometime between July 1 - 3 (see Table 7). The ratio of the total number of the days pollution occurred showed that mid-July had the least (14%), the first part of July had 28%, and the last part of July had the highest, 58 %. Highly concentrated Ox appeared mostly in the last part of July following the end of the rainy season. Along the northeast coasts of Tokyo Bay and Osaka Bay, the number of days in which highly concentrated Ox

appeared was greater during the first and middle parts of July than in the last part of July (see Fig. 6). Further, when the month was divided into smaller periods, it was 6% in July 16 - 20, but 34% in July 27 - 31, showing a great difference between the periods. When the appearance of highly concentrated Ox and the weather conditions, particularly the rainy season, are compared, there are many days with a let up in rain during the periods in which highly concentrated Ox appeared frequently (see Table 10). From this, it is clear that these high concentrations of Ox (day's highest concentration above 10 pphm/hr, or above 50 pphm·hr Ox dose between 9:00 A.M. - 4 P.M.) can appear even during the rainy season.

2) State of photo-chemical oxidant warning issued during July - August.

The tate of photo-chemical oxidant warnings issued is as show in Table 5. Saitama prefecure heads the list with warnings issued 15 times, followed by Kanagawa prefecture 12 times, Tokyo Metropolis 11 times, and Osaka prefecture 11 times. In addition to these four prefectures, there are 11 prefectures which issued warnings more than five times. They include Chiba, Shizuoka, Kyoto, Hyogo, Hiroshima and Ehime. There were 21 prefectures where the appearance of highly concentrated oxidant which required warnings during July - August was seen. Those 21 prefectures included the prefectures which issued warnings less than 4 times. The total number of warnings issued was 118.

Not many warnings were issued in July because the rainy season lasted until after the 20th of July. An increasing tendency was seen in August, except in Ehime prefecture which issued fewer warnings in August than in July (3 warnings were issued in July).

Fig. 5. The level of Ox pollution in different areas. (July, 1974)

図5　Ox 汚染程度の地域別傾向（１９７４年7月）

Fig. 5 continued.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory notes.
d. Level of pollution.
X Day's highest concentration below 7 pphm.
O Day's highest concentration 8 - 14 pphm or day's dose 50 - 79 pphm•hr.
● Day's highest concentration 15 pphm or above ; day's dose 80 pphm•hr or above.
( ) no measurement was taken for more than 4 days.

Table 7. The number of days in which highly concentrated Ox appeared (the total number of days for each individual bloc) in July 1974.

Key: a. Name of the bloc.
b. Hokkaido-Tohoku.
c. Kanto
d. Kanto bloc except Tokyo.
e. Tokyo
f. Total
g. Chubu
h. Kinki
i. Chugoku-Shikoku.
k. Kyushu
l. Ratio
m. Level of Ox pollution.
n. Total
o. Number of measuring points.
p. Shifting

Note: Levels of Ox pollution.
A indicates the day's highest concentration of Ox was above 10 pphm or the day's Ox dose (9:00 A.M. - 4:00 P.M.) was over 50 pphm•hr.
B indicates the day's highest concentration of Ox was over 15 pphm or the day's Ox dose (9:00 A.M. - 4:00 P.M) was over 80 pphm•hr.

Fig. 6.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory note.
The timing of the appearance of Ox.
X No appearance.
◑ The first and middle part of the month = the last part of the month.
◐ First and middle part of the month > the last part of the month.
● " < "
d. Note: 1 - 20th of the month is termed the first and middle part of the month, after 21st is termed the last part of the month.

Table 7. The number of days in which highly concentrated Ox appeared (the total number of days for each individual bloc) in July 1974.

a ブロック名		Ox汚染程度	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20	21 22 23 24 25	26 27 28 29 30 31	計	測定地点数
b 北海道 東北		A						1 1 1	3	11
		B						0 0 0	0	
c 関東	d 除東京	A	1 3 1 1	1 2 9 1	1 3 6	2	8 1 1	3 9 6 5 6 3	73	17
		B	0 0 0 0	0 0 1 0	0 1 0	1	4 0 0	3 3 2 0 1	16	
	e 東京	A	3	11 1	3	4	8 8	3 9 2 8 1 4	60	14
		B	0	7 0	0	0	0 0	0 5 0 0 0 0	12	
	f 計	A	1 6 1 1	1 2 20 2	1 3 3 6	6	16 4 1	6 18 8 13 7 7	133	31
		B	0 0 0 0	0 0 8 0	0 0 1 0	1	4 0 0	0 8 3 2 0 1	28	
中 g 部		A	1 2 3 2	1 1		1	3 2 1	4 3 2 5 1	32	14
		B	0 1 0 1	0 0		0	0 0 0	0 0 0 1 0	3	
近 h 畿		A	3 8 5	1 4	5 5	1 7 1	4 9 7 1	9 8 4 3	80	15
		B	0 1 0	0 1	0 0	0 1 0	0 0 0 0	0 0 0 0	3	
中国・四国 i		A	2 1 5 1 2	2 1 1 1 2	1	1	1 1 1 8 2	2	35	13
		B	0 0 1 0 0	1 0 0 0 0	0	0	0 0 0 1 0	0	3	
九 k 州		A	1				2 1 2 1	1	8	8(+2移動 p)
		B	0				0 0 1 0	0	1	
合計		A	3 7 23 9 3	2 2 5 26 4	7 8 3 6	7 9 1	7 10 28 17 5	20 27 11 22 8 11	291	92(+2移動 p)
		B	1 2 1	1 9	1	1 1	4 2	8 3 3 1	38	
l 比率		A	15%	13%	8%	6%	24%	34%		
		B	11%	26%	3%	5%	16%	39%		

Note ; 注： Ox汚染程度　AはOx日最高濃度10pphm以上または，Ox日dose(9～16時)50pphm・hr以上
Bは　〃　15pphm以上または，　〃　80pphm・hr以上

Key on page 45.

Fig. 6. Appearance of high concentrations of oxidant shown as a function of time. (Day's highest oxidant concentration above 10 pphm or day's Ox dose (9:00 A.M. - 4:00 P.M.) above 50 pphm·hr, July 1974)

図6 高濃度Oxの発現の時期別傾向
(Ox日最高濃度10pphm以上または，Ox日dose(9－16時)
50pphm·hr以上，1974年7月)

Key on page 45.

On August 3, Kanagawa prefecture recorded the highest oxidant concentration among all the days in which warnings were issued. The concentration was 32 pphm. Saitama, Tokyo and Shizuoka recorded oxidant concentrations of 25 pphm in the first part of August.

The following tendency was seen when careful attention was paid to the location of low or high pressure on the days in which photo-chemical smog warnings were issued over relatively large areas in July and August of 1974.

July 3 (Wednesday)

Areas where warnings were issued: 4 prefectures in Kansai*; Osaka, Okayama, Hiroshima and Ehime.

Location of low or high pressure: A Tsuyu** front extended along the south coast of Japan but a let up in the rain was seen in the Kansai area because the front moved to the Japan Sea. It was raining in northern and north-eastern Japan.

July 9 (Tuesday)

Areas where warnings were issued: 5 prefectures in Kanto; Ibaragi, Saitama, Chiba, Tokyo and Kanagawa.

Location of low or high pressure: Western Japan and Kanto were under the influence of a high pressure region located over the ocean to the south of Japan. On the other hand, a front existed from the center of the Japan Sea tothe open sea off Sanriku. It was a south-high pressure, north-low pressure type of day.

It was cloudy and partly clear in the Kanto area and west of Ise Bay

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* Translator's note: sic.

** Translator's note: Tsuyu refers to the rainy season of Japan which comes around the time the fruit from plum trees is harvested.

was overcast. It was cloudy and rained at some places along the Japan Sea and Tohoku.

July 27 (Saturday)

Areas where warnings were issued: 4 prefectures: Ibaragi, Saitama, Tokyo and Chiba.

Location of low or high pressure: The entire nation was under a belt of high pressure off the Pacific Ocean.

It was cloudy and partially cloudy with rain in some areas. The other areas were mostly clear. The wind was weak in the Kanto area.

August 1 (Thursday)

Areas where warnings were issued: 5 prefectures; Tokyo, Kanagawa, Shizuoka, Mie and Kyoto.

Location of low or high pressue: High pressure off the Pacific Ocan extended to the west, and the region west of the Kansai area was under high pressure. It was a south-high pressure, noth-low pressure type of day.

Eastern Japan was mostly clear with some clouds and scattered showers in some places. The rest of the country was clear.

August 2 (Friday)

Areas where warnings were issued: 5 prefectures; Kanagawa, Kyoto, Osaka, Hyogo and Nara.

Location of low or high pressure: High pressure located southeast of Chisima extended to the open sea off Sanriku and to the Kanto area.High pressure also existed over the ocean south of Kyushu. At the same time, there was a front over the ocean southeast of the Kanto area, but the country was mostly under a high pressure area. Northern Japan

was either cloudy or had drizzle. The other areas were mostly clear.

August 3 (Saturday)

Areas where warnings were issued: 10 prefectures: Saitama, Chiba, Tokyo, Kanagawa, Aichi, Mie, Kyoto, Osaka, Hyogo and Okayama.

Location of low or high pressure: A front existed from the Korean Peninsula to Sakhalin, but Japan was mostly under a high pressure area. It was a south-high pressure, north-low pressure type of day. Northern Japan was cloudy and there were heavy showers in the southern part of the Tohoku area, but the rest of the country was mostly clear.

August 4 (Sunday)

Areas where warnings were issued: 6 prefectures; Ibaragi, Saitama, Chiba, Tokyo, Kanagawa, and Kyoto.

August 5 (Monday)

Areas where warnings were issued: 7 prefectures; Ibaragi, Saitama, Chiba, Tokyo, Kanagawa, Shizuoka and Kyoto.

August 6 (Tuesday)

Areas where warnings were issued: 9 prefectures; Ibaragi, Saitama, Chiba, Tokyo, Kanagawa, Shizuoka, Mie, Shiga and Kyoto.

Location of low or high pressure: A front extended from the middle of the Japan Sea to Hokkaido, but the country was under a high pressure area due to the influence of the Pacific high, except Hokkaido and the northern part of Tohoku. It was a south-high pressure, north-low pressure type of day.

8/4 Many clouds in Hokkaido and the northern part of the Tohoku area. The other areas were clear.

8/5 The Tohoku area was cloudy and had rain in some parts, the other areas were mostly clear.

8/6 Some parts of Hokkaido and the Tohoku area had rain, but other areas were mostly clear.

August 10 (Saturday)

Areas where warnings were issued: 5 prefectures; Shizuoka, Osaka, Hyogo, Wakayama and Hiroshima.

Location of low or high pressure: A weak tropical low pressure existed over the ocean far south of Osaka Bay, but the country was generally under a high pressure area. It was clear nationwide but the southern part of the Kanto region had many clouds.

August 19 (Monday)

Areas where warnings were issued: 5 prefectures, Tokyo, Kanagawa, Osaka, Hyogo and Ehime.

Location of low or high pressure: Typhoon No. 14 was located over the East China Sea, but the nation was sandwiched between the high pressure area over the middle of the Japan Sea and another over the open sea off Sanriku. The nation was under a high pressure area with a gentle pressure inclination. The entire nation was either clear or cloudy, and the southern part of the Kanto region was calm.

August 20 (Tuesday)

Areas where warnings were issued: 5 prefectures; Saitama, Tokyo, Osaka, Hiroshima and Ehime.

Location of low or high pressure: The entire nation was under a high pressure area due to the influence of high pressure located over the Continent and the Japan Sea. It was a north-high pressure, south-low

pressure type of day.

There were scattered showers along the Pacific Coast of southern Kyushu, but the other areas were mostly clear.

August 22 (Thursday)

Areas where warnings were issued: 7 prefectures; Saitama, Tokyo, Kanagawa, Osaka, Nara, Hiroshima and Yamaguchi.

Location of low or high pressure: Tropical low pressure existed over the East China Sea and over the ocean far east of the Izu Islands, but the country was under a high pressure area and the inclination of the atmospheric pressure gradient was gentle.

The Kanto area had clouds but the other areas were mostly clear.

Thus, those days in which photo-chemical smog warnings were issued over a relatively large area were either under high pressure or were influenced by high pressure areas.

However, it is assumed that parts of Hokkaido and the prefectures bordering the Japan Sea did not reach concentrations of Ox over 15 pphm·hr even under a high pressure area because substances with a potential for causing photo-chemical reaction were low. It should be possible to predict the potential danger by making a detailed study in each area of photo-chemical smog and the weather conditions including the amount of sunshine, altitude of the temperature inversion, wind direction, wind velocity and the movement of fronts.

3) The status of SO_2 and NO_2.

Fig. 7 shows the nationwide level of SO_2 pollution from the standpoint of the day's average value (9:00 A.M. - 4:00 P.M.) as a function of

the time of the month. It shows that the locations of high concentration (over 21 pphm·hr) are concentrated in Kanto, the Tokai areas and the coast lines of Osaka Bay and the Seto Inland Sea. A high concentration was also noted at the measuring points in Toyama and Ohita prefectures. A comparison of Ox and the concentration of SO_2 showed that they did not necessarily show the same tendency.

The month's average value for the degree of NO_2 pollution in terms of the day's dose (9:00 A.M. - 4:00 P.M.) is shown in Fig. 8. The data show that the areas of high concentration (over 17 pphm·hr) tend to concentrate along the Pacific side of Japan, particularly around Tokyo and Osaka. This same tendency was seen with Ox and SO_2. However, there was no constant relationship among Ox, SO_2 and NO_2 at individual measuring points.

7. A Summary of the Amount of Precipitation and the Highest Daytime Temperature throughout Japan in July, 1974.

As shown in Appendix 6, the amount of precipitation in July, 1974 was greater than that of a normal year and the end of the rainy season was rather late nationally, except for Sapporo, Aomori, Gunma, Ibaragi, Saitama, Ehime, Miyazaki, Kagoshima and Kumamoto. (The nationwide average for the amount of precipitation for the month calculated by using Appendix 6 is as follows. The value for a normal year is 208.5 mm compared to this year's value of 326.7 mm. This year's nationwide average value for the amount of precipitation for the month was 118.2 mm 64% higher than a normal year.) The month's average value for the highest daytime temperature corresponds with this, and except for Aomori and Kagoshima, it was 0.1° C

(Kumagaya) - 35° C* (Kofu) lower than the value for a normal year. (Based on Appendix 6, the nationwide average for the month's average value of the highest daytime temperature was 29.1° C for a normal year and 27° C for this year. The nationwide average was 1.5° C lower.) It is thought that these weather conditions had some effect on the growth of plants.

A comparison of Sapporo, which has the lowest amount of precipitation in a normal year, and Kumamoto, which has the highest amount, showed that there was a difference of 267.3 mm in a normal year and 278.0 mm difference in 1974. Similarly, a comparison of the month's average value for the highest daytime temperature between Kyoto, which has the highest value in a normal year, and Sapporo, which has the lowest, showed a difference of 63° C** in a normal year and 4.8° C in 1974.

8. Growth of the Morning Glories.

The morning glories used for the survey were cultivated by the direct seeding method. They were seeded simultaneously nationwide on May 15. Table 9 shows the growth in height of the plants and the numbers of leaves on July 29. The table shows the observations individually bloc by bloc. As shown in Table 9, it is clear that the farther north the bloc, the lower the height of the plants. Compared to the average value of 331 cm in the Kyushu bloc farthest south, the average value for the Hokkaido Bloc, the most northern bloc, was 87 cm, showing a considerable difference.

On the other hand, the average number of leaves in each bloc was as follows. The Chugoku-Shikoku Bloc had the most (40) followed by the Kyushu Bloc (39), the Chubu Bloc, and the Kinki Bloc (38 each). There was hardly

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*Translator's note: sic. I think it is a misprint for 3.5° C.

**Translator's note: sic. It is most likely a misprint for 6.3° C.

Fig. 7. Area distribution map of the degree of SO_2 pollution (month's average value of day's dose, July, 1974).

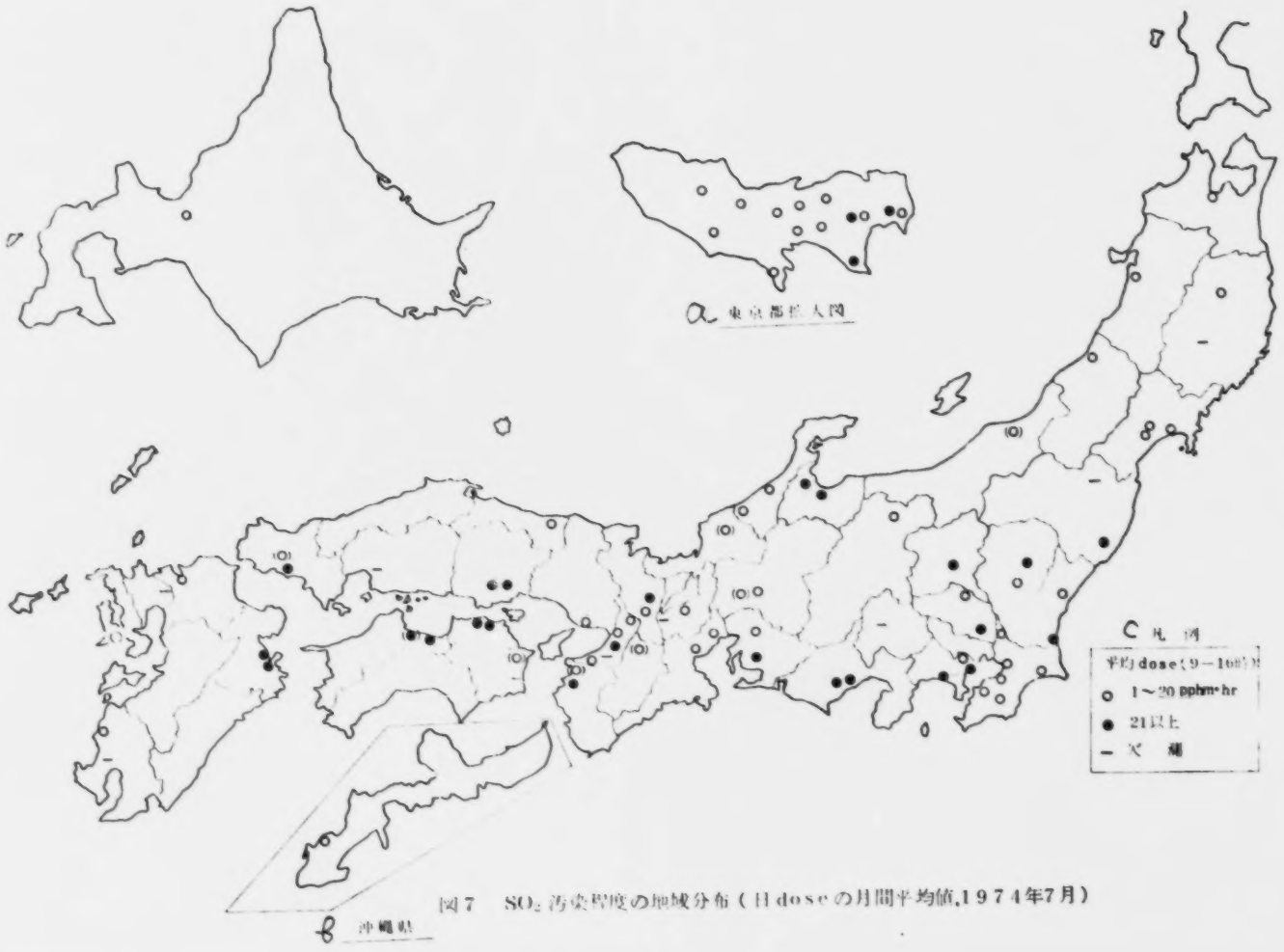


図7　SO_2 汚染程度の地域分布（日doseの月間平均値,1974年7月）

Fig. 7. continued.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory note.
Average dose (9:00 A.M. - 4:00 P.M.)
0 1 - 20 pphm hr
● over 21
- no measurement was taken.

Fig. 8.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory note.
Average dose (9:00 A.M. - 4:00 P.M.)
0 1 - 16 pphr hr
● over 17
- no measurement was taken.

Table 8.

Key:
a. Miyagi
b. Ibaragi
c. Tochigi
d. Gunma
e. Saitama
f. Chiba
g. Tokyo
h. Kanagawa
i. Shizuoka
j. Aichi
k. Mie
l. Shiga
m. Kyoto
n. Osaka
o. Hyogo
p. Nara
q. Wakayama
r. Okayama
s. Hiroshima
t. Kagawa
u. Ehime
v. Yamaguchi
w. Tokushima
x. Ohita
y. Total
z. Grand total.

Fig. 8. Area distribution map of the level of NO_2 pollution (month's average value of day's dose, July 1974).

図8　NO_2の汚染程度の地域分布（日doseの月間平均値,1974年7月）

Key on page 56.

Table 8. The date of emergency measure (warnings) issued.

July, 1974 August 1974

	3	9	14	20	22	23	24	26	27	28	29	31	計	1	2	3	4	5	6	7	8	9	10	11	13	14	15	19	20	21	22	23	24	28	小計	合計
宮 a 城																																				
茨 b 城		19							21	15			3				18	17	20	20						○									5	8
栃 c 木										15			1																			15		1	2
群 d 馬																																				
埼 e 玉		23				21			24	21	19	19	6			28	26	26	30	22					22				22		21	19			9	15
千 f 葉		17	19			17			30				4			20	19	16	21							27									5	9
東 g 京		24							18				2	17		25	22	19	19							20		16	19		18				9	11
神 奈 川		23											1	17	18	32	29	16	17		16					25		15		19	19				11	12
静 i 岡														18				15	15	15	25		17	16											7	7
愛 j 知																18																			1	1
三 k 重														16		24			24																3	3
滋 l 賀																			18																1	1
京 m 都														15	21	24	19	18	20						22									7	7
大 n 阪	19				16								2		24	19						23	20		17			21	18		23			23	9	11
兵 o 庫					15								1		17	16						19	22					19							5	6
奈 p 良															17																18				2	2
和 q 歌 山																							22												1	1
岡 r 山	23												1			17										17									2	3
広 s 島	19			18									2								15		19						15		16	17			5	7
香 t 川																									15					18					2	2
愛 u 媛	17						16	16					3															17	17						2	5
山 v 口				16									1											17							○	○			3	4
徳 w 島							21						1																							1
大 x 分																																				
〆計	4	5	1	2	2	2	2	1	4	3	1	1	28	5	5	10	6	7	9	3	3	2	5	2	4	4		5	5	2	7	3	1	1	90	118

Note: The number indicated is the highest concentration of Ox in pphm.

Key on page 56.

Table 9. Growth of the morning glories in each bloc.

(July 29, 1974)

		i 最高	j 最低	k 平均値
a 北海道東北ブロック	g 草丈 cm	294	22	87
	h 全葉数 枚	36	12	21
b 関東ブロック	g 草丈	400	19	189
	h 全葉数	50	10	23
c 中部ブロック	g 草丈	450	70	242
	h 全葉数	57	20	38
d 近畿ブロック	g 草丈	430	57	294
	h 全葉数	53	14	38
e 中国・四国ブロック	g 草丈	540	120	327
	h 全葉数	59	20	40
f 九州ブロック	g 草丈	454	190	331
	h 全葉数	59	24	39

Key: a. Hokkaido-Tohoku Bloc.
b. Kanto Bloc.
c. Chubu Bloc.
d. Kinki Bloc.
e. Chugoku-Shikoku Bloc.
f. Kyushu Bloc.
g. Height of the plant (cm).
h. The total number of leaves.
i. The nighest.
j. The lowest.
k. Average value.

any difference in the number of leaves among the 4 blocs in western Japan. The Kanto Bloc (23) and the Tohoku-Hokkaido Bloc (21) had a smaller number of leaves than any bloc in western Japan. A tendency for a decreasing average number of leaves was seen; the farther north the bloc, the smaller the number of the leaves.

Thus, throughout the nation, bloc by bloc the average value of the height of the plant was lower the farther north. No clear difference in the number of leaves was seen among the blocs south of the Chubu Bloc, though a slightly lower tendency was seen in the Kanto Bloc and the Hokkaido-Tohoku Bloc.

As shown in Table 9, there was an average of 21 leaves on July 29 in the Tohoku Bloc where the growth was the slowest. Damage by oxidant was noticed twice in July, even on the morning glories at Hichigo Junior High School in Sendai which had the second lowest number of leaves (15) in the country. This indicates that the morning glories at each of the schools participating in the survey had a degree of sensitivity sufficient for the survey.

9. A Summary of the Appearance of Damage to the Morning Glory due to Ox.

1) The state of damage in July.

(1) Distribution of the schools where damage appeared and the degree of damage.

During July, some kind of damage due to oxidant was noticed at 72 participating Junior High Schools in 27 prefectures. The highest amount of damage was seen at the participating schools near four industrial areas surrounding Tokyo Bay, Ise Bay, Osaka Bay and the Seto Inland Sea. Also

light damage was seen at the schools participating in the survey in some areas facing the Pacific Ocean (Sendai, Iwaki, Mito, Shizuoka, Kochi and Miyazaki) and Kawauchi(Kagoshima). Damage was also seen in the Kofu basin where geographically strong independent elements exist.

The degree of damage to the morning glory expressed in the cumulative number of damaged leaves is shown in Fig. 9. In the Kanto area which surrounds Tokyo Bay the damage was slightly lower in schools along the bay and tended to be heavy in the schools away from the Bay. (When the damage is below 10% of the leaf area, it is termed light, 10 - 20% is termed moderate. It is termed heavy when the damage is over 21% of the leaf surface.) In the areas around Ise Bay, Osaka Bay and the Seto Inland Sea, the damage was heavy in most of the schools participating in the survey.

The degree of damage seen in the schools participating in the survey in the rest of the areas was relatively low, ranging from light to moderate.

(2) The first day damage appeared in July and the frequency of damage.

As shown in Table 10, damage appeared early in 1 - 2 schools participating in the survey in the four areas where the damage was concentrated. The first damage appeared successively in the other participating schools in the neighbouring areas. An early appearance of the damage was seen before July 5 in each case (see Fig. 10 and 11). In the area surrounding Tokyo Bay, the first damage was seen in 2 schools on July 3. They are Higawa Junior High School (Tokyo) located in an inland area and Nakawada Junior High School (Yokohama) by the bay. Along Ise Bay, the first damage was seen at Kyonan Junior High School (Tsu) and Tokiwa Junior High School

Fig. 9. Cumulative rate of damage to the leaves in July.

図9　7月の累積被害葉率（1974年）

Fig. 9 continued.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory notes.
Rate of damage.
X indicates none.
O - 10% (light)
◐ 11 - 20% (moderate)
● over 21% (heavy)

Fig. 10. The day when the first damage appeared in July, 1974.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory note.
O The first part of the month.
◐ The middle part of the month.
● The last part of the month.
X none
- no measurement was taken.

Fig. 11. The number of times damage appeared in July, 1974.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory note.
The number of times damage appeared.
X no damage
O 1 ~ 4 times.
● more than 5 times.
- Measurement was not taken.

Fig. 12. Findings of the continuous, regular and supplementary surveys made in August, 1974.

Key: a. Enlarged map of Tokyo Metropolis.
b. Okinawa prefecture.
c. Explanatory notes.
O There was damage.
● The first damage appeared in August.
X There was no damage.

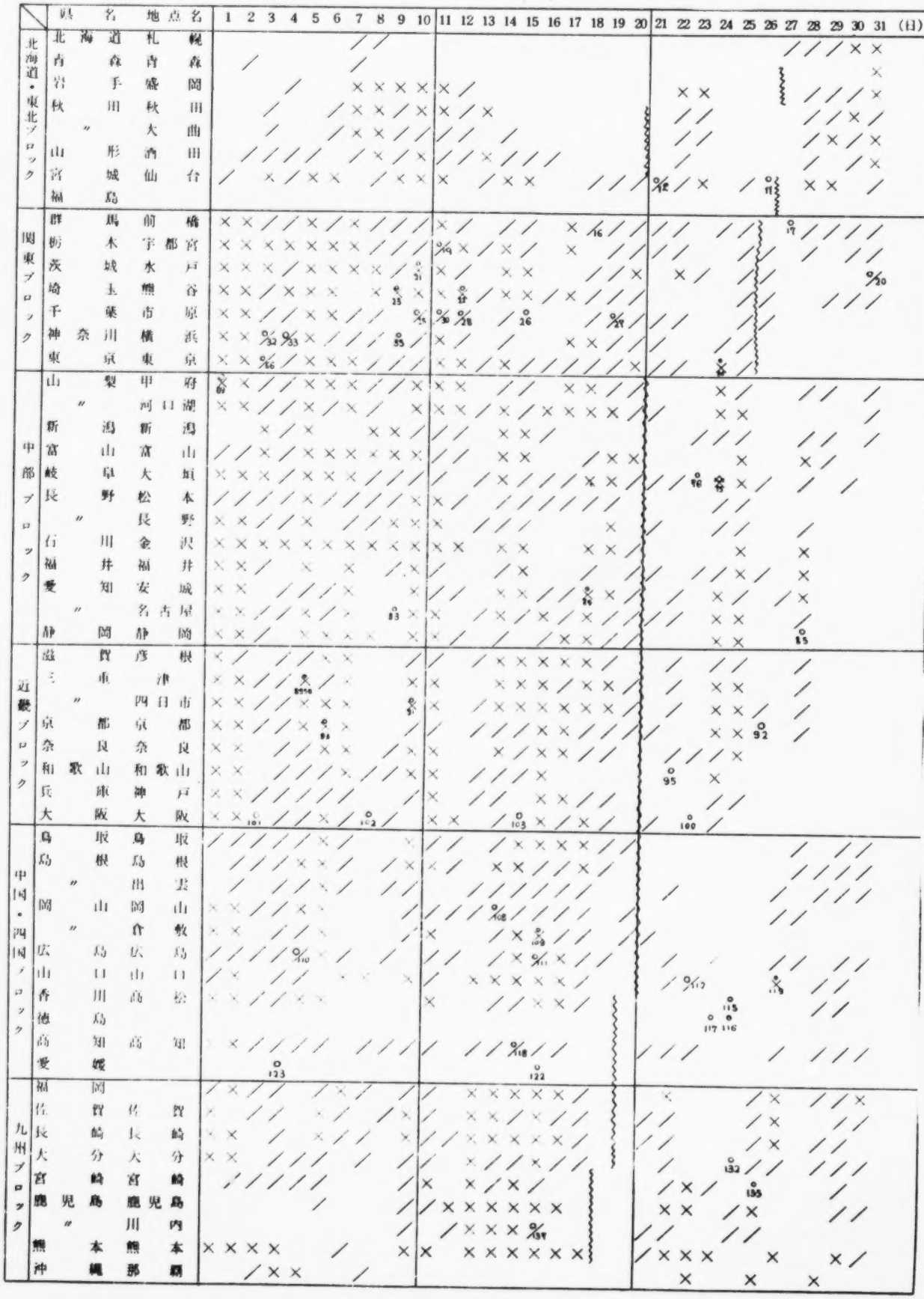


Table 10. The weather and the first day in which damage appeared in July (1974).

Table 10. The weather and the first day in which damage appeared in July (1974).

Explanatory Note: No mark indicates clear or cloudy.
X indicates rain or occasional rain during the day.
/ indicates a shower.
≷ indicates that the rainy season is over.
The numbers in the table indicate the no. of the school participating in the survey.

O indicates that the first damage appeared on this day.

Key: a. Names of the cities and prefectures.
b. Date
c. Hokkaido-Tohoku Bloc.
d. Sapporo, Hokkaido.
e. Aomori, Aomori.
f. Morioka, Iwate.
g. Akita, Akita.
h. Ohmagari, Akita.
i. Sakata, Yamagata.
j. Sendai, Miyagi.
k. Fukushima (prefecture).
l. Kanto Bloc.
m. Maebashi, Gunma.
n. Utsunomiya, Tochigi.
o. Mito, Ibaragi.
p. Kumagaya, Saitama.
q. Ichihara, Chiba.
r. Yokohama, Kanagawa.
s. Tokyo, Tokyo.
t. Chubu Bloc.
u. Kofu, Yamanashi.
v. Kawaguchiko, Yamanashi.
w. Niigata, Niigata.
x. Toyama, Toyama.
y. Ohgaki, Gifu.
z. Matsumoto, Nagano.
aa. Nagano, Nagano.
bb. Kanazawa, Ishikawa.
cc. Fukui, Fukui.
dd. Anjyo, Aichi.
ee. Nagoya, Aichi.
ff. Shizuoka, Shizuoka.
gg. Kinki Bloc.
hh. Hikone, Shiga.
ii. Tsu, Mie.
jj. Yotsukaichi, Mie.
kk. Kyoto, Kyoto.
ll. Kobe, Hyogo.
mm. Osaka, Osaka.
nn. Chugoku-Shikoku Bloc.
oo. Tottori, Tottori.
pp. Shimane, Shimane.
qq. Izumo, Shimane.
rr. Okayama, Okayama.
ss. Kurashiki, Okayama.
tt. Hiroshima, Hiroshima.
uu. Yamaguchi, Yamaguchi.
vv. Takamatsu, Kagawa.
ww. Tokushima (prefecture).
xx. Kochi, Kochi.
yy. Ehime (prefecture).
zz. Kyushu-Bloc.
aaa. Fukuoka (prefecture).
bbb. Saga, Saga.
ccc. Nagasaki, Nagasaki.
ddd. Ohita, Ohita.
eee. Miyazaki, Miyazaki.
fff. Kagoshima, Kagoshima.
ggg. Kawanouchi, Kagoshima.
hhh. Kumamoto, Kumamoto.
iii. Nawa, Okinawa.

Fig. 10. The day when the first damage appreared in July, 1974.

第10 7月の被害初発日（1974年）

Key on page 64.

Fig. 11. The number of times damage appeared in July, 1974.

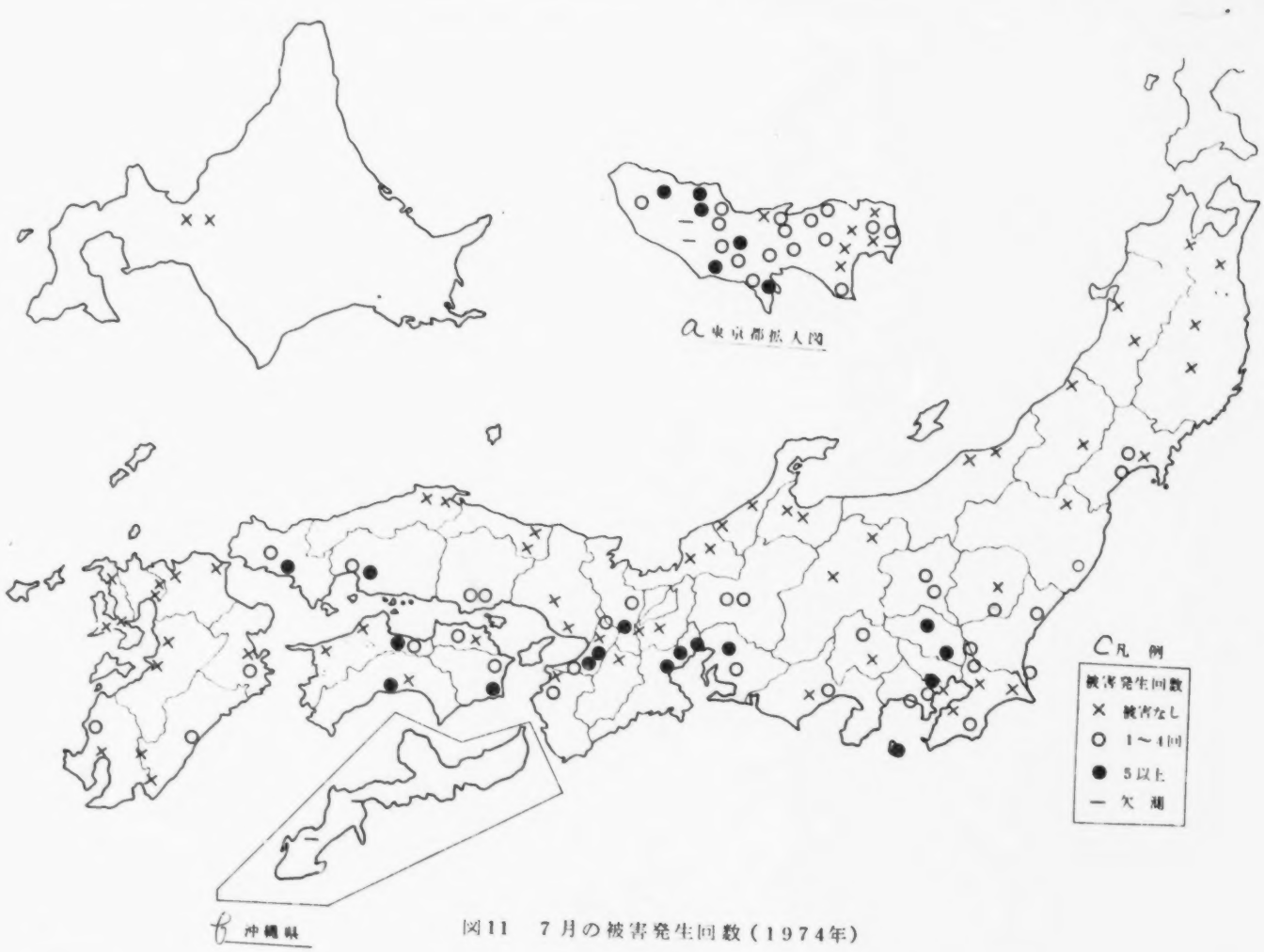


図11　7月の被害発生回数（1974年）

Key on page 64.

Fig. 12. Findings of the continuous, regular and supplementary surveys made in August, 1974.

図12　8月連続，定期，不定期，補足調査における被害の有無（1974年）

Key on page 69.

(Yotsukaichi) on July 5. Along Osaka Bay, the first damage appeared at Shiki Junior High School (Hachio) on July 3. Along the Seto Inland Sea, the first damage appeared at Nakahagi Junior High School (Shinguhama) on July 4. The first appearance at the other schools followed these one after another.

As is well known, the photo-chemical reaction is greatly influenced by the amount of sunshine (the amount of ultraviolet light). Therefore, the photo-chemical reaction does not progress much during the rainy season even though substances causing the reaction are abundant in the air. Accordingly, the total amount of oxidant generated during the same period should be less than before and after the rainy season.

This year, the rainy season ended in Okinawa on June 30, around July 18 in the Kyushu area, and it was July 26 for the latest area, the Tohoku area. Except for Okinawa and Hokkaido, 2/3 of July was in the rainy season in Japan. In spite of this, damage appeared in 51 schools (equivalent to 72% of the schools) out of 71 during the rainy season (see Table 10). Judging from this fact, it seems that the relatively short periods of sunshine between rains during the rainy season generate concentrations of Ox (average value for 1 hour is around the 8 pphm level, 9:00 A.M. - 4:00 P.M. Ox dose was around 50 pphm•hr) sufficiently high to affect plants like the morning glory which are sensitive to Ox damage.

(3) Areas where damage was not seen in July.

During July, which was the nationwide simultanious survey period, Ox damage was not seen on morning glories in the following areas. They are: Hokkaido, Aomori prefecture, Iwate prefecture, Akita prefecture, Yamagata prefecture, Niigata prefecture, Nagano prefecture, Ishikawa prefecture, Toyama prefecture, Fukui prefecture, Shiga prefecture, Nara prefecture,

Hyogo prefecture, Tottori prefecture, Shimane prefecture, Saga prefecture, Kumamoto prefecture, and Okinawa prefecture.

2) State of damage in August.

In August, voluntary surveys were made in a total of 98 schools in 36 prefectures. The voluntary surveys consisted of daily surveys, regular or irregular surveys, and supplementary surveys through the last part of August to the first part of September. The results of these surveys are arranged in Fig. 12.

Damage was recoginized in several additional areas, though no damage was seen there in July. These were 3 prefectures on the side of the Japan Sea, Niigata (the first damage appeared at Higashi Niigata Junior High School on August 14), Toyama (Ohizumi Junior High School, the first damage was seen during the first and middle part of August), Fukui (the first damage was seen at Myodo Junior High School on August 1) and Saga (Kiri Junior High School, August 7). Damage was seen in July and August in the following 20 prefectures, Miyagi, Fukushima, Ibaragi, Tochigi, Gunma, Chiba, Tokyo, Kanagawa, Yamanashi, Shizuoka, Gifu, Aichi, Mie, Kyoto, Wakayama, Hiroshima, Yamaguchi, Kagawa, Kochi and Miyazaki. Damage was seen in July in Ehime but not in August. On the other hand, no damage was seen during either July or August in 11 prefectures, Hokkaido, Aomori, Iwate, Akita, Yamagata, Nagano, Shiga, Hyogo, Tottori, Shimane, and Kumamoto.

3) Conclusion.

(1) Ox damage appeared on morning glories in the following 27 prefectures in July. They are:Miyagi, Fukushima, Ibaragi, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Yamanashi, Shizuoka, Gife, Aichi, Mie, Kyoto, Osaka, Wakayama, Hiroshima, Yamaguchi, Kanagwa, Tokushima, Ehime,

Kochi, Ohita, Miyazaki and Kagoshima.

(2) Ox damage was considerable in four areas along Tokyo Bay, Ise Bay, Osaka Bay and the Seto Inland Sea.

(3) Ox damage did not appear in Hokkaido, the northern parts of the Tohoku area, along the coast of the Japan Sea, or northern and western Kyushu.

(4) In August, damage appeared for the first time in 3 prefectures along the coast of the Japan Sea, Niigata, Toyama, Fukui, and in Saga prefecture.

(5) In the central part of an area where particulary heavy damage appeared (Tokyo), there were areas where the damage was light.

(6) In areas where Ox damage was considerable, the damage not only appeared early but also appeared frequently.

10. Relationship between Ox Concentration and the Appearance of Damage.

Specific days on which Ox appeared over a large area were selected and the highest concentration and dose of Ox and the amount of damage to the morning glories were compared. The selected day for the Tohoku, Kanto (including Tokyo) and Chubu blocs was July 27. July 26 was selected for the Kinki, Chugoku-Shikoku and Kyushu-Okinawa blocs. Newly damaged plants with damage appearing 1 - 2 days after the appearance of Ox were used for comparison.

Fig. 13 and Fig. 14 show the day's highest concentration of Ox and the appearance of damage. In the areas north of Kanto, the damage tends to appear when the day's highest Ox concentraion is above the 8 pphm level and the dose over the 45 - 55 pphm·hr level. West of Kansai, the

damage is inclined to appear when the Ox concentration is above the 7 pphm level and the dose over the 40 - 50 pphm·hr level. As has been shown, there are some differences among the areas, but the damage did appear when the day's highest concentration was over 8 pphm or the dose over 50 pphm·hr, and in most cases damage did not appear when the concentration was below these levels.

Further studies will be required to determine the cause of these differences between the areas north of Kanto and the areas west of Chubu. The weather, particularly the effect of temperature and the different amounts of growth of the morning glory, are suspected to be the cause of the differences.

There were cases where no direct relationship was seen between the appearance of Ox and the damage appearing on the plants. In order to find the cause for this, it will be necessary to study once again the relationship between the measuring point and the location where the plants are growing, the growth stage of the plants, the condition of nutrition of the plants, the system used for observation, etc.

11. Relationship between the Day's Concentration Level for Each Pollutant and the Appearance of Damage.(Analysis of an example.)

In 5 out of 6 blocs in the nation, one or two schools which were relatively close to the measuring point of the pollutants and where the morning glories were growing well were selected. The Hokkaido-Tohoku Bloc was excepted because there was hardly any damage in the bloc. The schools were selected for the purpose of studying the relationship between the degree of damage and the concentration of pollutants at the measuring point.

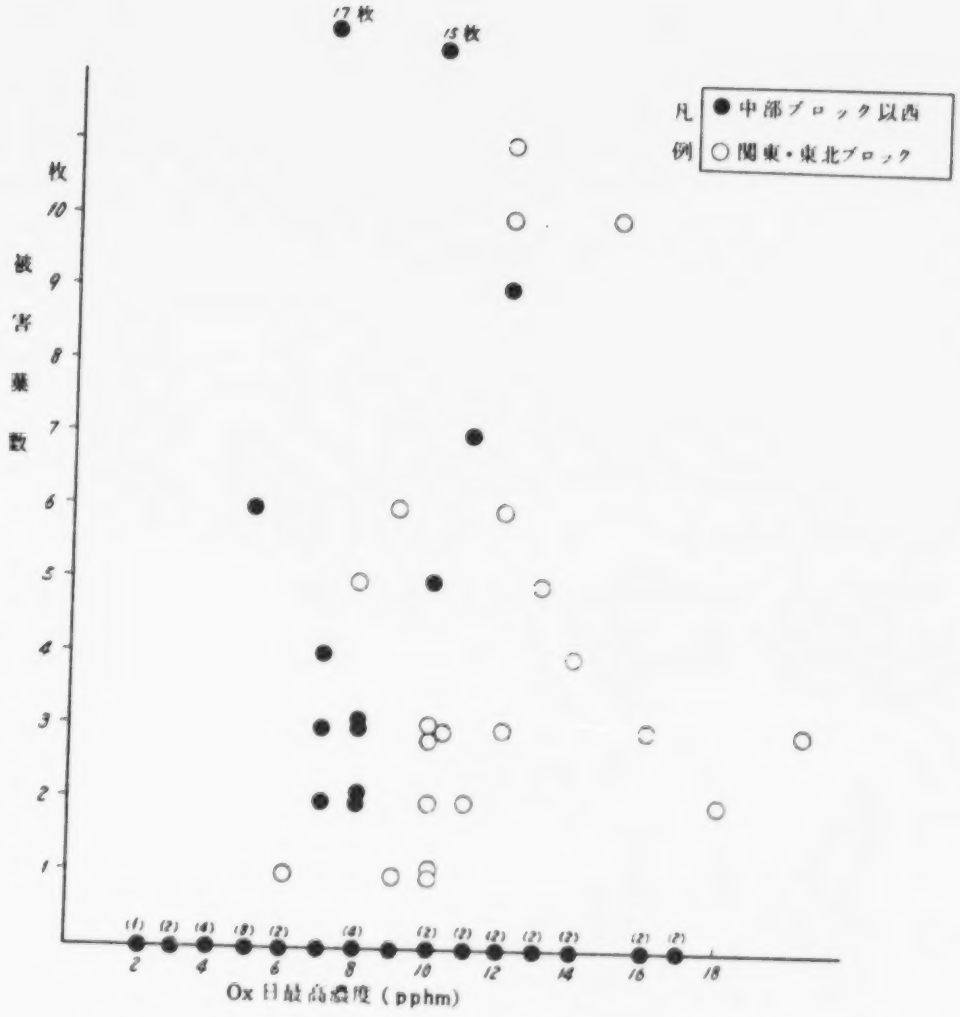


Fig. 13. Relationship between damage to the morning glory and the day's highest Ox concentration (July, 1974).

Note: The days in which Ox appeared: ● July 26 O July 27 (when there was no damage, no distinction between the blocs was indicated).
The day on which damage appeared on the plants: 1 - 2 days after Ox appeared.
The number inside ( ) indicates the number of places where damage appeared.

Key: a. The number of leaves damaged
b. The day's highest Ox concentration (pphm).
c. 17 leaves.
d. 15 leaves.
e. Explanatory note:
● West of the Chubu Bloc.
O Kanto and Tohoku blocs.

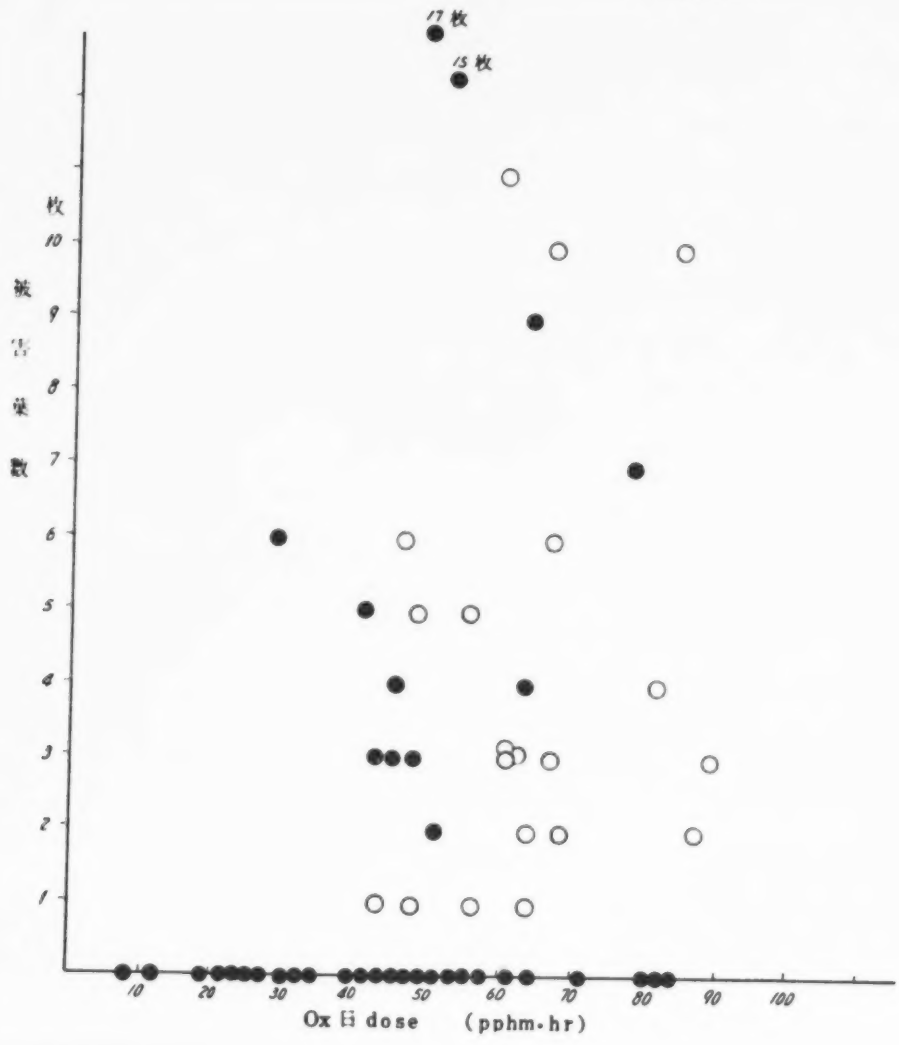


Fig. 14. Relationship between day's Ox dose and damage to the morning glory (July, 1974).

Note: The day in which Ox appeared: ● July 26 ○ July 27 (no distinction among the blocs is made when there was no damage). The day in which the damage to the plants appeared: 1 - 2 days after appearance of Ox.

Key: a. The number of damaged leaves.
b. Day's Ox dose (pphm·hr).

1) The Kanto Bloc.

In Hachiohji City of the Tokyo Metropolis, the distance between the Hachiohji Measuring Center and No. 4 Junior High School, Hachiohji City Schools, was 2.5 km and the distance was 0.1 km between No. 5 Junior High School, Hachiohji City Schools, and the measuring center. A day by day comparison of the damage to the morning glories at these schools and the concentration of pollutants (Ox, SO_2 and NO_2) at the Hachiohji Measuring Center is shown in Fig. 15 - 1.

First of all, the figure indicates that damage was seen on July 10. It was believed that the day's highest Ox concentration of 12 pphm, day's Ox dose 57 pphm·hr (9:00 A.M. - 4:00 P.M.), on the previous day, the 9th, corresponds to the damage noticed on the 10th. (Hereafter, the day's highest Ox concentration will be termed simply the highest Ox value, day's Ox dose will be termed the Ox dose.)

In addition, damage was seen daily from July 27 to July 30. The state of Ox pollution was as follows: Ox dose on the 26th was 63·pphm hr, 67 pphm·hr on the 27th, 42 pphm·hr on the 28th, and 55 pphm·hr on the 29th. A high level of pollution was seen every day corresponding to the damage seen.

Fig. 15 - 2 shows the highest Ox value and the Ox value of the preceeding day for each of the days on which damage was or was not seen separately. The threshold level for whether damage does or does not appear is an Ox value of 8 pphm, an Ox dose of 50 pphm·hr.

The SO_2 concentration was low through out the month and caused no acute damage.

The NO_2 concentration was rather high, but the virulence of NO_2 is

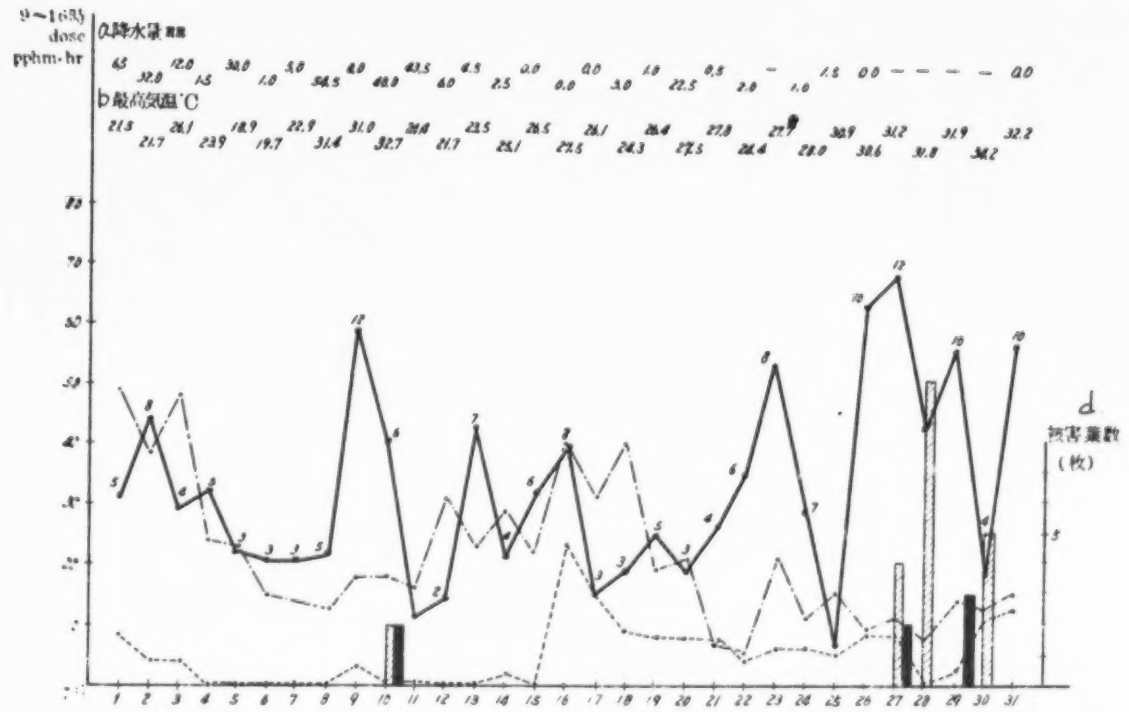
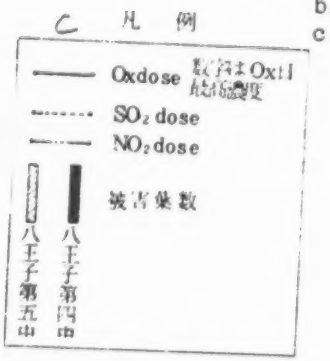


Fig. 15 - 1. Relationship between exposure to pollutants and the appearance of damage.
(Hachiohji Measuring Center and No. 4 and No. 5 Junior High Schools, Hachiohji City Schools, Tokyo Metropolis, July 1947)

Key: a. The amount of precipitation. mm
b. The highest temperature. °C
c. Explanatory note.
—— Ox dose. The number indicates the day's highest Ox concentration.
- - - SO_2 dose
—·—·— NO_2 dose
d. The number of leaves damaged.



No. 5 Junior High No. 4 Junior High, Hachiohji City Schools.

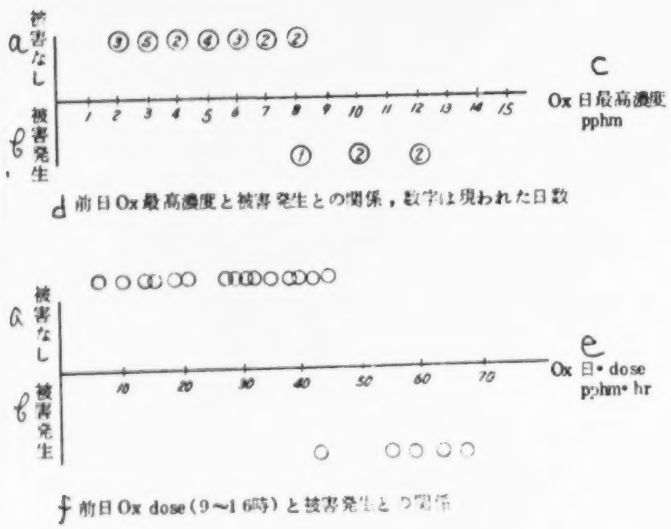


Fig. 15 - 2. Relationship between the degree of Ox pollution and the appearance of damage. (Hachiohji Measuring Center, Hachiohji No. 4 and No. 5 Junior High Schools, Hachiohji City Schools, Tokyo Metropolis, July, 1974)

Key: a. No damage.
b. Damage appeared.
c. The day's highest Ox concentration pphm.
d. Relationship between the appearance of damage and the previous day's highest Ox concentration. The number indicates the number of days.
e. The day's Ox dose pphm·hr.
f. Relationship between the appearance of damage and the Ox dose (9:00 A.M. - 4:00 P,M,) on the day before.

weak and this level does not cause acute harm.

The sites of the plantings of morning glories at both schools were sunny with good ventilation.

The growth of the morning glories was satisfactory.

2) Chubu Bloc

The Chuoh Measuring Center which is the nearest to Umebayashi Junior

High School, Gifu City Schools, is about 2 km from the school. But this measuring Center frequently missed Ox measurements. Therefore, the data collected at Nanbu Measuring Center which is 4 km from the school were used.

As shown in Fig. 16, damage appeared 3 times during a short period in the last part of July, the 24th, 28th and 30th. Correspondingly, the Ox concentration was low until the last part of the month. During the last part of the month, on the 22nd, 23rd, 26th, 27th and 29th, Ox pollution with an Ox dose of 44 - 52 pphm·hr was seen. Damage appeared on a considerable number of leaves, 12 leaves, on the 24th. It is considered that this considerable damage was due to the fact that the pollution continued throughout the 22nd and 23rd and also because there were many undamaged leaves present which were senstive to Ox.

From the figure, it can be seen that in Gifu damage appeared when the highest Ox value was over 8 pphm and the Ox dose was over 44 pphm·hr.

The concentration of SO_2 was low but NO_2 was high. However, as far as can be determined from the figures, they did not have much effect on the morning glories. (It is believed that the concentration of NO_2 was high because this measuring center faced a road used by automobiles.)

The growth of the morning glories was satisfactory. The height of the plants was 380 cm, the total number of leaves (on the main vine only) was 38.

3) Kinki Bloc.

Two schools in the Kinki Bloc were studied. They were Kita Uji Junior High School, Uji City Schools, Kyoto prefecture, and Nagano Junior High School, Kawachi-Nagano City Schools, Osaka prefecture.

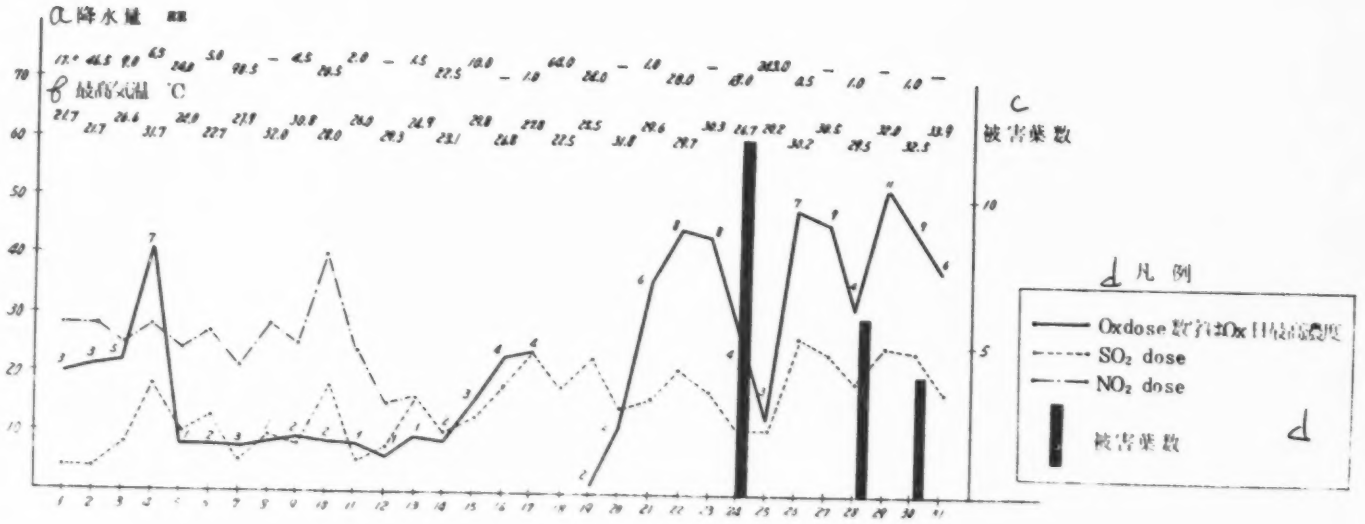


Fig. 16. Relationship between the appearance of damage and exposure to pollutants.
(Nanbu Measuring Center and Umebayashi Junior High School, Gifu prefecture, July 1974.)

Key: a. The amount of precipitation. mm
b. The highest temperature. °C
c. The number of leaves damaged.
d. Explanatory notes.
——— Ox dose. The number indicates the day's highest Ox concentration.
----- SO_2 dose
NO_2 dose
The number of leaves damaged.

The measuring center closest to Kita Uji Junior High School is about 1.6 km* from the school. The distance between Nagano Junior High School, Osaka prefecture, and the measuring center is very close, 0.2 km.

(1) Kita Uji Junior High School, Uji City Schools, Kyoto prefecture.

As shown in Fig. 17, damage was already seen on July 6. An Ox dose of 67 pphm·hr and a highest Ox value of 13 pphm were recoreded two days earlier. On the 10th, first degree damage appeared on 2 out of a total of 18 leaves. On the 8th and 9th, the Ox dose was 40 - 45 pphm·hr, and the highest value of Ox was 9 pphm. There was precipitation totaling 57 mm on the 7th. It was clear on the 8th and 9th and the temperature rose suddenly during this period. The damage appeared even though the concentration was relatively low because under these weather conditions the morning glories were in a state where they could be damaged easily.

The Ox concentration was low through the 10th - 18th and no damage appeared on the morning glories. Damage appeared again on the 21st, but no measurements were taken on the 19th and the concentration of Ox was low on the 20th. It was not possible to find pollutant conditions corresponding to the damage which appeared on the 21st.

Following the damage appearing on the 21st, damage also appeared on the 23rd. 6 out of 26 leaves were damaged. The damage was caused by a 62 pphm hr·Ox dose and the highest value of Ox was 13 pphm. On the 27th, damage appeared on 8 leaves all at once. This was due to the Ox pollution of the 26th, which had an Ox dose of 63 pphm·hr, and the highest value of Ox was 12 pphm.

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*Translator's note: It looks like 16 km in the text, but most likely a decimal point is missing.

All these indicate that a considerable amount of damage appears when the Ox dose is above 58 pphm·hr and the highest Ox value is over 12 pphm. However, when the plant is susceptible to damage, damage does appear even at an Ox dose level of 45 pphm·hr, the highest value of Ox being 9 pphm.

(2) Nagano Junior High School, Kawachi-Nagano City Schools, Osaka prefecture.

As shown in Fig. 18, damaged leaves appeared continuously one after another from the middle part of the month. They appeared on July 18, 22 and 27. The Ox dose was 52 - 46 pphm·hr on the preceeding days. The highest Ox value was 9 pphm on the 21st and 11 pphm on the 17th and 27th. This can be considered to correspond to the damage done to the morning glories.

On July 7 and 8 in the first part of the month, damage appeared but pollution corresponding to these days was not found even though the measuring center was close to the school.

The planting areas were in sunny spots and the growing conditions were good at both Kita Uji and Nagano Junior High Schools.

4) Chugoku-Shikoku Bloc.

The state of damage to the morning glory at Kuwayama Junior High School, Bofu City Schools, in Yamaguchi prefecture and the data concerning pollution collected at Bofu City Hall were compared. The distance between them is about 0.5 km.

As shown in Fig. 19, on July 23 the first damage was observed. Then damage was noted every day on the 26th through the 30th. The pollution corresponding to these dates was an Ox dose of 50 - 80 pphm·hr and a highest

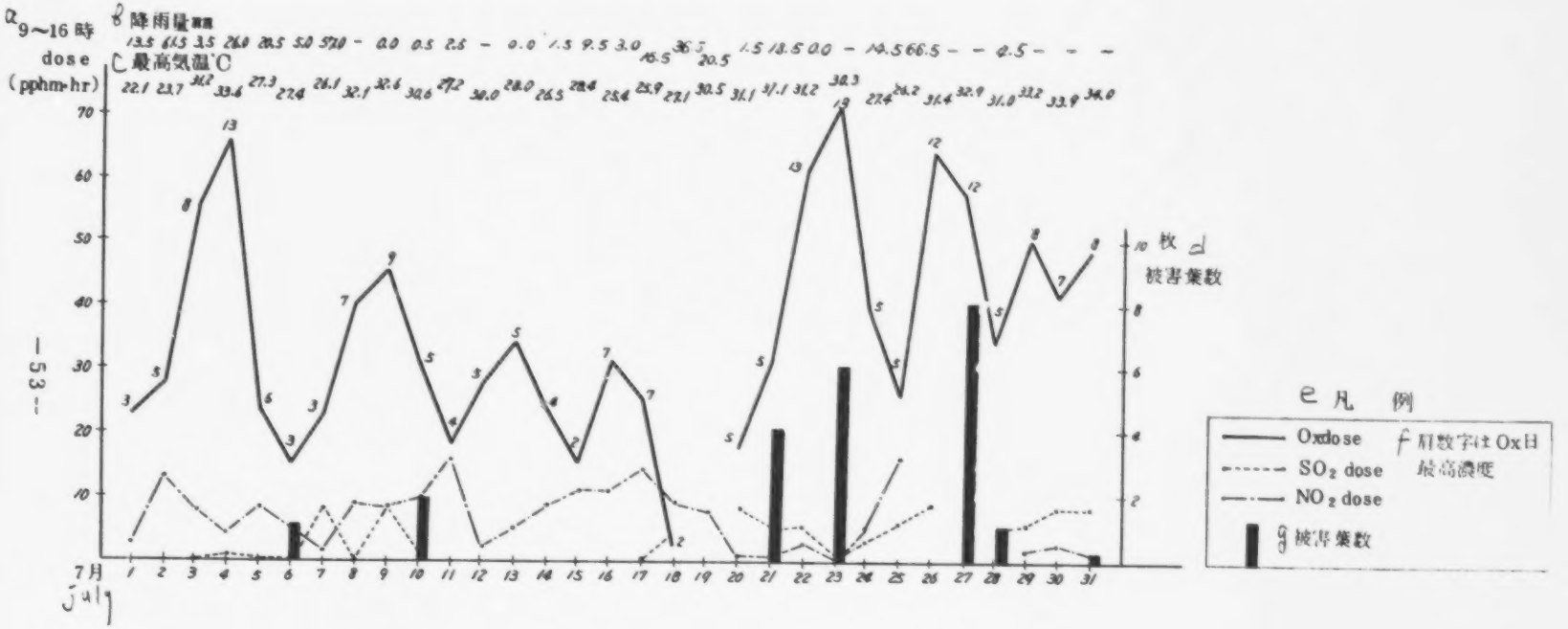

Fig. 17. Relationship between the appearance of damage and exposure to pollutants. (Uji Measuring Center and Kita Uji Junior High School in Kyoto prefecture, July, 1974.)

Kye: a. 9:00 A.M. - 4:00 P.M.
b. The amount of precipitation. mm
c. The highest daytime temperature. °C
d. The number of damaged leaves.
e. Explanatory note.
f. The number above indicates the day's highest Ox concentration.
g. The number of damaged leaves.

Ox value at the 10 - 11 pphm level. The degree of damage was relatively low, first or second degree, and necrosis was not seen.

In August, damage continued to appear daily from the 9th - 12th and the degree of damage was heavy, second or third degree, during the four days, 8 - 11, highly concentrated pollution appeared; the lowest Ox dose was 53 pphm·hr and the highest was 97 pphm·hr, the highest Ox value was 10 -17 pphm. These correspond to the continued heavy damage to the morning glories.

Also, from August 15 to 21st, damage consisting of white spots appeared every day. It is considered that this is because a heavy Ox dose over 65 pphm·hr with the highest Ox value at 11 pphm appeared on August 15 and 16.

In general, during mid and late August, it seemed that the damage frequently appeared at slightly lower Ox concentrations than in July.

The planting area was sunny and had good ventilation. In the last part of July, the height of the plants was 295 cm and the total number of leaves was 29. In the last part of August, the height of the plants was 485 cm and the total number of leaves was 72. The growth was good.

5) Kyushu Bloc.

The results obtained at Jyoto Junior High School where no damage appeared and Daizai Junior High School where damage appeared were studied. Both schools are in Ohita prefecture. The distance between the schools and the measuring centers was 0.8 km and 1.2 km.

(1) Jyoto Junior High School.

As shown in Fig. 20, the highest Ox dose in July was relatively low,

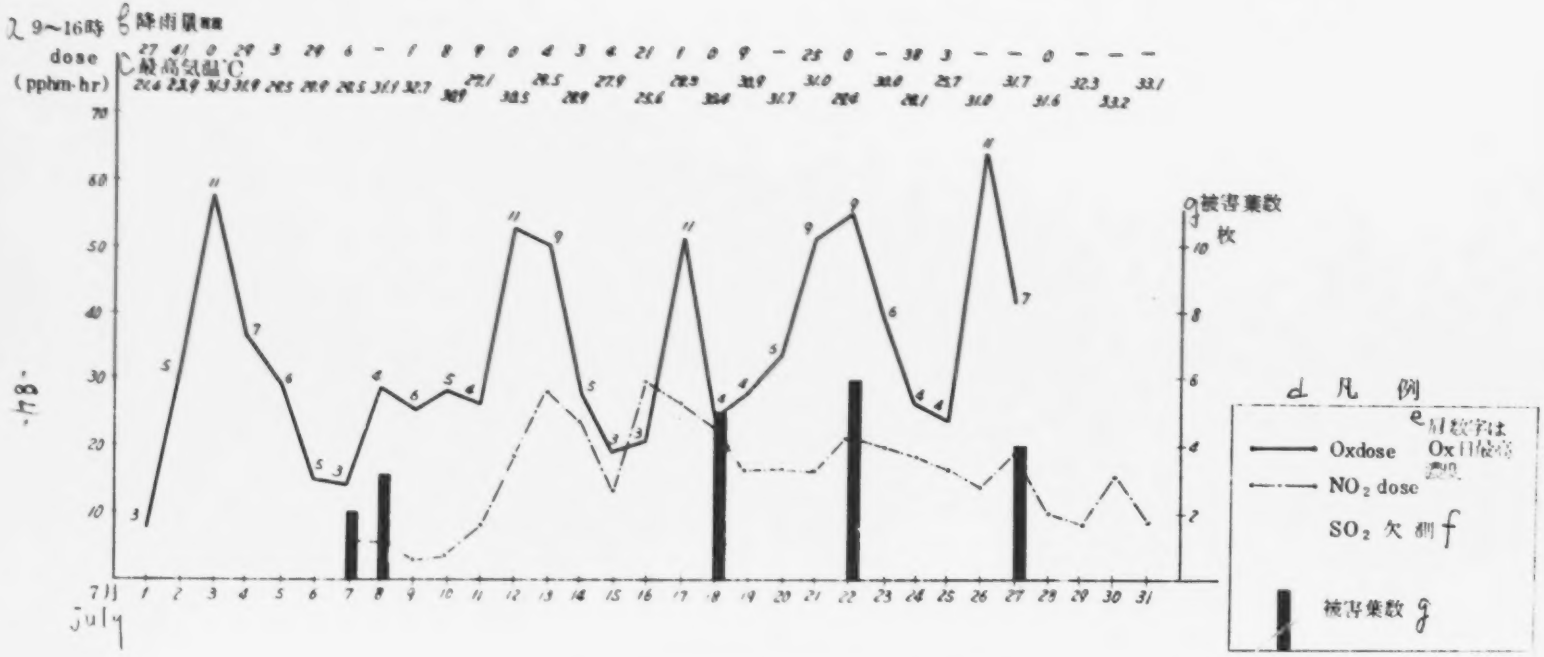

Fig. 18. The relation between the appearance of damage and exposure to pollutant. (The measuring center at Nagano Elementary School, Kawachi-Nagano City, Osaka prefecture and Nagano Junior High School, July 1974.)

Key: a. 9:00 A.M. - 4:00 P.M.
b. The amount of precipitation. mm
c. The highest temperature. ^{o}C
d. Explanatory note.
e. The number on the shoulder indicates the day's highest Ox concentration.
f. Measurement was not taken.
g. The number of damaged leaves.

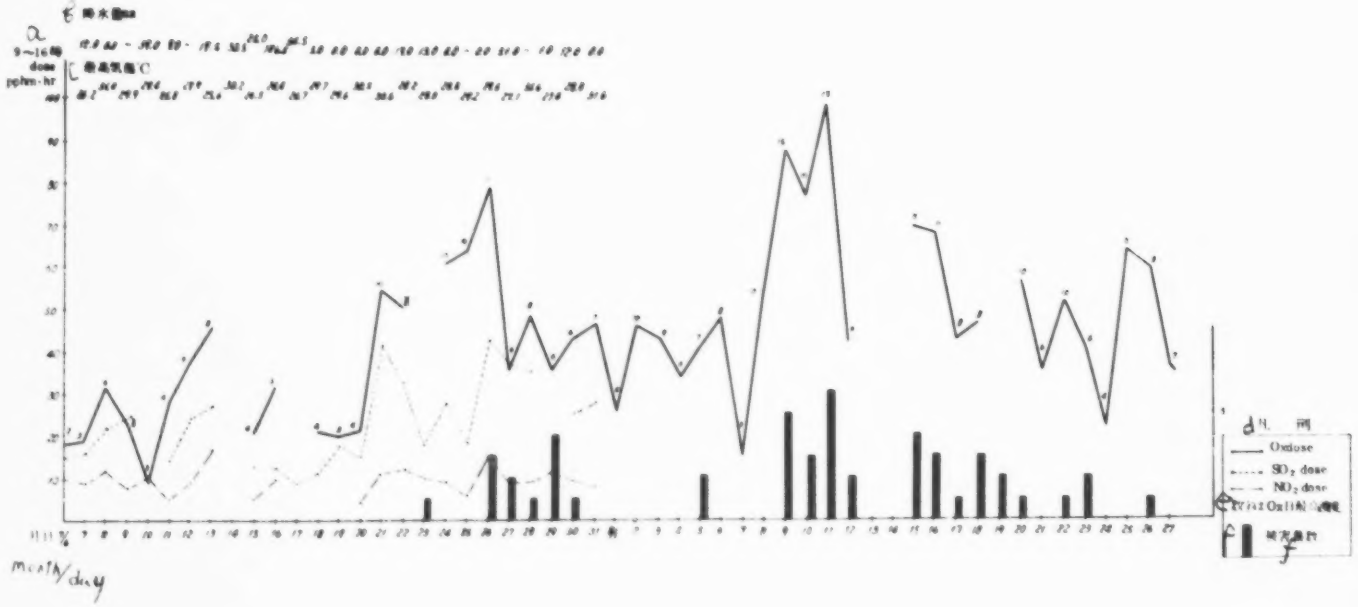

Fig. 19. Relationship between the appearance of damage and exposure to pollutants.
(The measuring center at Bofu City Hall, Yamaguchi prefecture, and Kuwayama Junior High School, July and August, 1974.)

Key: a. 9:00 A.M. - 4:00 P.M.
b. The amount of precipitation. mm
c. The highest temperature. °C
d. Explanatory note.
e. The number indicates the day's highest Ox concentration.
f. The number of damaged leaves.

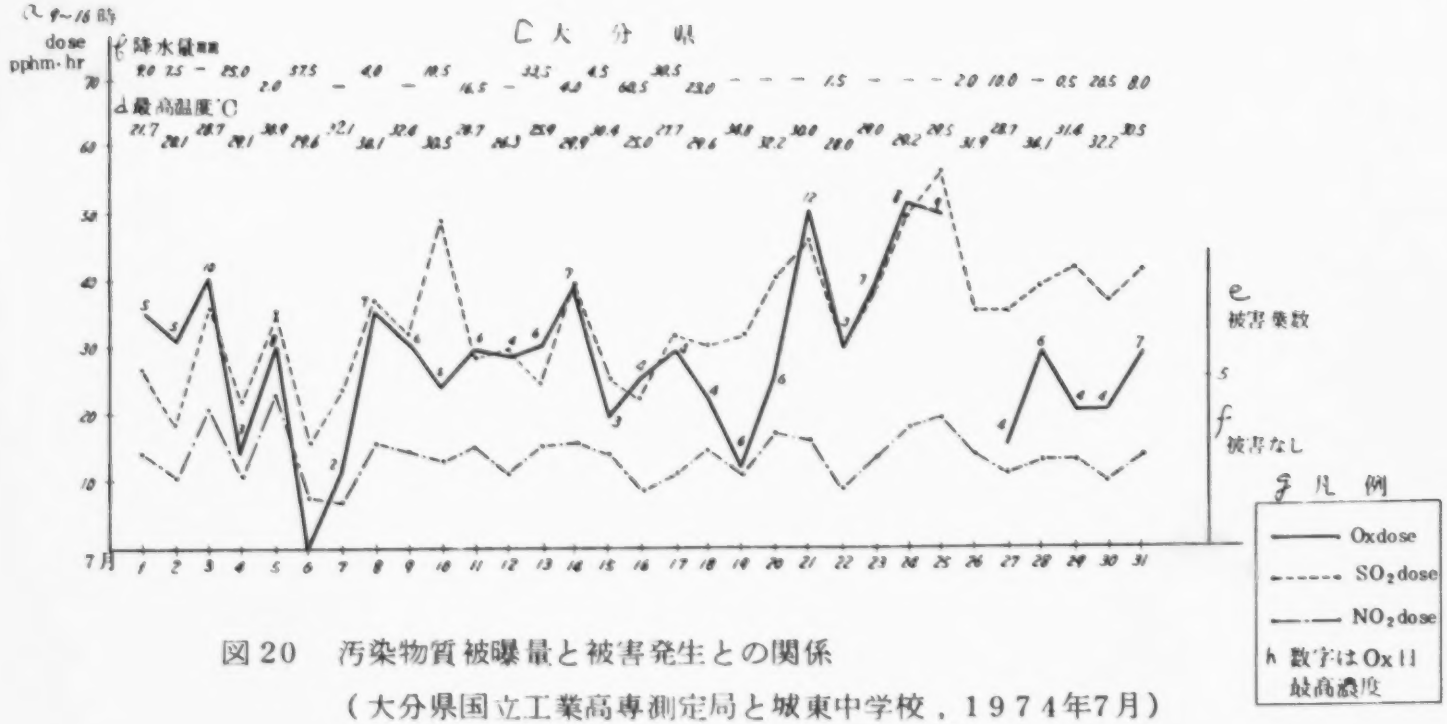

図20　汚染物質被曝量と被害発生との関係

（大分県国立工業高専測定局と城東中学校，1974年7月）

Fig. 20. Relationship between the appearance of damage and exposure to pollutant.
(The measuring center at the College of Industry (National), Ohita prefecture, and Jyoto Junior High School, July, 1974.)

Key: a. 9:00 A.M. - 4:00 P.M.
b. The amount of precipitation. mm
c. Ohita prefecture.
d. The highest temperature. °C
e. The number of damaged leaves.
f. No damage.
g. Explanatory note.
h. The number indicates the day's highest Ox concentration.

50 pphm·hr. The highest Ox concentration in July was recorded on July 20. It was 12 pphm. It is thought that no damage was caused by this because this was the value after 3 P.M. and it was below 5 pphm prior to 1:00 P.M.

All through July, Ox doses of approximately 50 pphm·hr did not cause damage. Damage did not appear even when the highest Ox value was 8 - 9 pphm.

The concentration of NO_2 was low but SO_2 was considerably higher. There was no damage as a direct result of these.

The growth was good.The height of the plants was 330 cm and the number of leaves was 43 in the last part of July.

(2) Daizai Junior High School.

Prior to July 22, the Ox dose was at the 40 pphm·hr level and no damage was seen. As shown in Fig. 21, July 24 recorded the highest amount of pollution for July with an Ox dose of 88 pphm·hr, the highest Ox concentration being 13 pphm. Correspondingly, on the following day, July 25, on 5 leaves an 80% rate of damage with bleached spots and necrosis appeared.

On July 27, a bleached spot of light damage, first degree, and dark brown spots appeared on 2 leaves. These correspond to an Ox dose of 52 - 53 pphm·hr, the highest Ox values being 8-9 pphm on the 25th and 26th.

When the Ox dose or the highest Ox value is relatively low, the damage resulting from this is light damage in the first degree. When the value is high, heavy damage accompanied by necrosis appears.

12. The Results of the Midway Simultaneous Survey by the Members of the Committee of Experts and the Executive Committees.

In the areas where making judgements concerning visible damage was difficult due to the lack of examples of damage by Oxidant in the past,

the survey was made simultaneously by members of the Committee of Experts. The period of the survey was July 24 - August 2.

In the prefectures where it was not possible to make a simultaneous survey by the members of the Committee of Experts, the members of the Executive Committees of Prefectures and Junior High Schools were asked to cooperate and make a survey simultaniously as much as possible during the said period.

The simultaneous survey by the members of the Committee of Experts was made in the following areas.

They are: Aomori, Akita, Yamagata, Iwate, Miyagi, Fusushima, Niigata, Nagano, Yamanashi, Ishikawa, Toyama, Fukui, Gifu, Mie, Shiga, Nara, Wakayama, Osaka, Tottori, Shimane, Yamaguchi, Kagawa, Ehime, Kochi, Tokushima, Fukuoka, Saga, Ohita, Kumamoto, Miyazaki, Chiba, Kanagawa, Tokyo (34 prefectures, 83 schools).

In the following prefectures, the information was obtained by the members of the Executive Committee (Prefectures and Junior High Schools).

They are: Kyoto, Ibaragi, Aichi, Shizuoka, and Kagoshima (5 prefectures and 9 schools.)

1) The method used for the survey.

Using cards provided for the simultaneous survey, the total number of leaves (A), the number of damaged leaves (B), rate of damaged leaves (B/A X 100), the height of the plant and the symptoms of damage according to the location of the leaves (proportions of the damaged area, whether necrosis existed or not) were surveyed. Pictures were taken as needed.

2) Summary of the results of the survey.

(1) A detailed study of the nationwide distribution of damage found

that most of the damage was concentrated in the Kanto and Tokai areas and the coasts of the Seto Inland Sea. Damage was also seen in Miyagi prefecture in the Tohoku area and Ohita and Miyazaki prefectures in Kyushu.

It is noteworthy that damage were seen in Tokushima and Kochi prefectures in Shikoku along the Pacific Coast. (See Fig. 22)

The symptoms of damage were not seen in Hokkaido, along the coast of the Japan Sea, the Western part of Kyushu and Okinawa.

(Note) The above study took into account the information obtained by telephone from Hokkaido, Shimizu City, Itoh City, and Okinawa prefecture in addition to the results of the survey by the members of the Committee of Experts and the Executive Committees.

(2) The damage was notable in the Kanto area, the Osaka area and along the coast of the Seto Inland Sea. In these areas, symptoms of necrosis were recoginized in addition to white spots. (See the attached appendix 4)

(3) The growth of the morning glories was generally poor in the Tohoku area where the temperature was low. The height of most of the plants was 50 cm - 100 cm and some of them were only 15 cm high (No. 6 Junior High School, Yamagata City Schools). The growth of the plants was good in the rest of the areas and the height generally reached over 2 m.

(4) The weather conditions of July, 1974, were not suited for the generation of Oxidant caused by the photo-chemical reaction. This was because the rainy season lasted longer than usual and it was cold. When the results of the survey in August and September are obtained, more detailed actual conditions should be obtainable.

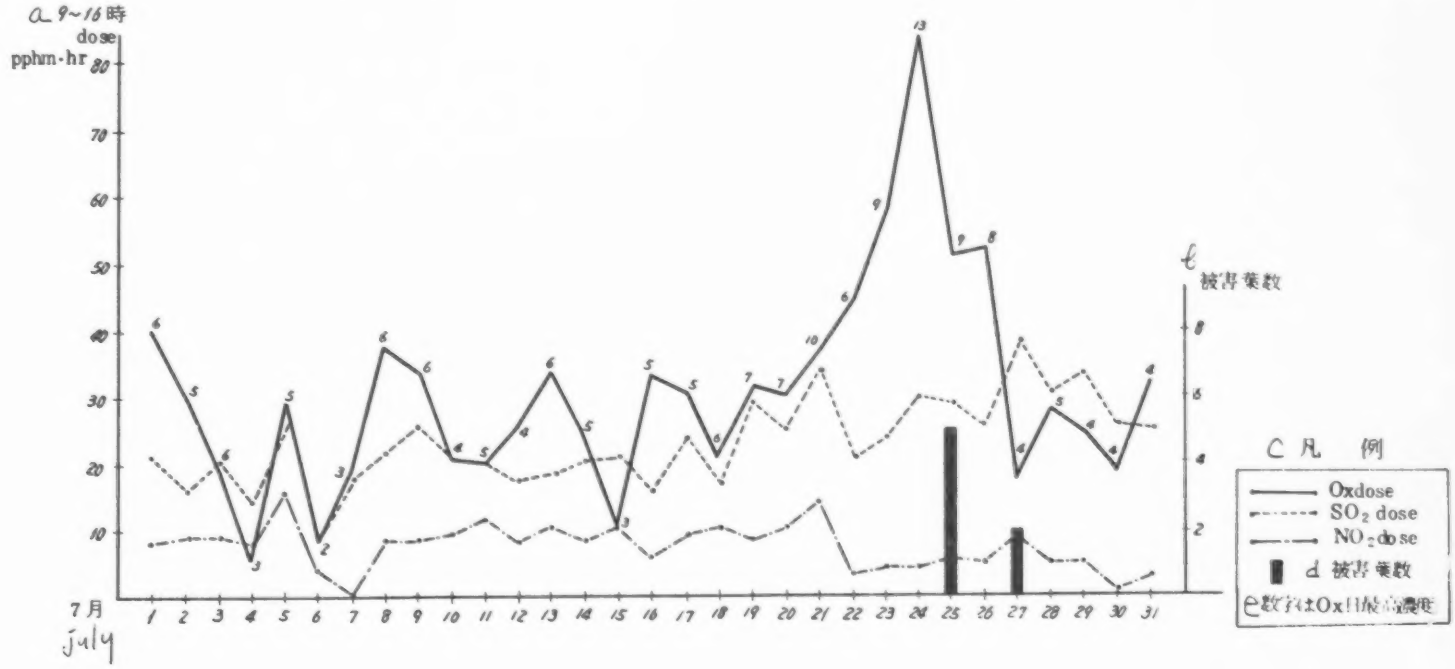

Fig. 21. Relationship between appearance of damage and exposure to pollutant. (The measuring center at Daizai Elementary School and Daizai Junior High School, July, 1974.)

Key: a. 9:00 A.M. - 4:00 P.M.
b. The number of damaged leaves.
c. Explanatory note.
d. The number of damaged leaves.
e. The number indicates the day's highest Ox concentration.

図22　アサガオのオキシダント被害分布図（1974年7月24日～8月2日調査）

Fig. 22. Map showing the distribution of damage to morning glories caused by oxidant.
(Surveyed July 24 - August 2, 1974.)
(There are instances where plants observed in this survey differed from the ones used for the survey of Fig. 9.)

Key: a. Enlarged map of Tokyo Metropolis.　　b. Okinawa prefecture.
c. Explanatory note.　X indicates no damage to the leaves.
O　Rate of damage to the leaves less than 20%.
O　"　more than 20%.

13. Conclusion.

The influence of photo-chemical smog was surveyed nationwide, June through July 1974, by using morning glories as indicators. This nationwide survey was sponsored by all of the 47 prefectures in the nation and the Yomiuri Newspaper Inc. with assistance from the Nationwide Society for Junior High School Science Education, the Environmental Agency, the Ministry of Education, the Ministry of Home Affairs and the Ministry of Agriculture and Forestry.

The members of the Executive Committee at the participating schools were reponsible for the Nationwide Simultatious Survey (July), the Voluntary Survey (June, August and September) and the Supplementary Survey. The results of these surveys and the data related to the environment were tabulated by members of the Executive Committee of each Prefecture and by members of the Executive Committee of the Secretary-General's Prefecture in each bloc.

In addition, a mid-way survey (from the last part of July to the first part of August) was made by the members of the Committee of Experts. They analyzed the results of all the surveys, including the ones discussed above. The following became clear:

1) During July and August, photo-chemical Oxidant emergency measures were issued in all the prefectures in the Kanto area except Gunma, and in Saitama Aichi, Mie, Shiga, Kyoto, Osaka, Hyogo, Nara, Wakayama, Okayama, Hiroshima, Kagawa, Ehime, Yamaguchi, and Tokushima (21 prefectures). Saitama prefecture led in the number of warnings issued with 15, followed by Kanagawa prefecture (12 times), Tokyo and Osaka (11 times). Eleven pre-

fectures issued warnings more than five times.

2) During July, which was the nationwide survey period, sixty measuring centers out of 94 measuring centers near the schools participating in the survey nationwide recorded values for day's highest Ox concentration over 10 pphm or a day's Ox dose (9:00 A.M. - 4:00 P.M.) over 50 pphm·hr.

The distribution included Miyagi and Niigata prefectures, all the prefectures in the Kanto Area, the coasts of Ise Bay and Osaka Bay and the prefectures bordering them.

It should be noted that the photo-chemical reaction advanced to Niigata, Ishikawa and Fukui on the coast of the Japan Sea.

3) The first day on which the day's highest Ox concentration exceeded 10 pphm or the day's Ox dose (9:00 A.M. - 4:00 P.M.) was over 50 pphm·hr in July was in the last part of July in the Hokkaido-Tohoku Bloc and between July 1 - 3 in all the other blocs.

The rate of the total number of days (having the concentrations mentioned above) was the lowest in the middle part of July, followed by the first part of the month, and the last part of the month was considerably higher.

4) Nationwide the amount of precipitation was 64% more than the nationwide average for normal year. The end of the rainy season came rather late.

Correspondingly, the nationwide monthly average value for the day's highest temperature in July, 1974, was 1.5° C lower than that of a normal year, and it is believed that this had an effect on the growth of the plants.

5) When the average number of leaves was looked at individually bloc by bloc, it was 21 - 23 leaves in the Hokkaido-Tohoku and Kanto Bloc. It was

38 - 40 leaves in the rest of the blocs. There was a difference in growth between the groups. However, as far as the number of the leaves at each school participating in the survey was concerned, it is considered that there was sufficient Ox sensitivity.

6) During July, Ox damage to the morning glory was seen at 74 schools in 28 prefectures. The damage was concentrated in and around the four industrial areas of Tokyo Bay, Ise Bay, Osaka Bay and the Seto Inland Sea. In addition, light damage was seen at the participating schools in some areas facing the Pacific Ocean (Sendai, Iwaki, Mito, Shizuoka, Kochi and Miyazaki) and Kawauchi (Kagoshima).

7) In July, the dates of the first appearance of damage to the morning glory were before July 5 in all areas except in Kyushu and Hokkaido-Tohoku blocs. Damage first appeared on July 3 in the Kanto area and the Osaka Bay area. It appeared on July 4 in the Seto Inland Sea area and July 5 in the Ise Bay area.

8) During July, Ox damage to the morning glory was not seen in 19 prefectures, Hokkaido, Aomori, Iwate, Akita, Yamagata, Niigata, Nagano, Ishikawa, Toyama, Fukui, Shiga, Hyogo, Tottori, Shimane, Fukuoka, Saga, Nagasaki, Kumamoto and Okinawa.

9) The voluntary survey of August was conducted at 81 schools in 37 prefectures. The survey showed that in 3 prefectures along the coast of the Japan Sea, Niigata, Toyama and Fukui, and Saga prefecture the first damage was noted in August.

10) Although there were some differences between different locations, the threshold value at which point damage appears on the morning glory is around a day's highest Ox value of 8 pphm and a day's Ox dose (9:00 A.M.-

4:00 P.M.) at the 50 pphm·hr level.

The results of the analyses made by comparing data from selected participating schools in each bloc and the daily Ox pollution level tended to show the same conclusions described above.

It became clear that, corresponding to the spread of oxidant pollution over large areas, symptoms of Ox damage were seen in 32 prefectures.

New information concerning damage was obtained from areas where the influence of photo-chemical oxidant on plants had not been clear. These areas include the coast of the Japan Sea, the areas in northeastern to southern and the Pacific coast of Shikoku.

11) The problem points which need further study after analyzing the results of this survey are (1) To find the cause when Ox pollution and appearance of damage do not correspond. (2) To find a method of introducing other indicator plants with different Ox sensitivity. (3) To find suitable methods for selecting schools to participate in the survey and selecting methods in accordance with the aim of the survey. (4) To make adjustments in the seeding time of the indicator plants and methods of cultivation and fertilizing.

The survey has been quite successful in putting the morning glory into practical use as an indicator of environmental pollution by Ox. The results of the survey will be useful in the future in adjusting and completing the network of environmental monitoring.

In the future, when this kind of survey enterprise is pursued, it will be desirable to provide thoughtful guidance to improve the techniques of observation by the surveyors. Moreover, methods of accumulating basic data for the survey and research on the methods of cultivation of not

only the morning glory but also other Ox indicator plants that might show a difference in sensitivity ought to be considered.

REFERENCE DATA

Problem points for the future.

At the close of the survey, the Executive Committee members in each school participating in the survey, the Executive Committee members in each prefecture and the Executive Committee members of the Secretary-General's Prefecture in each bloc, pointed out the problem points in the survey. Their comments are summarized as follows.

1) On operational organization and plans for enforcement.

The plan for the conducting the survey should be discussed carefuly in advance to avoid changes during the operation. There were many administrative requests, such as procedures for requesting cooperation, etc. from the administrative office to the organizations concerned. Procedures should be followed meticulously, addressing all communications to the head of the organization concerned. (Niigata, Aichi and others)

It was also desired that the administrative office keep close contact with the members of the Executive Committee of the prefectures and give assistance for the smooth execution of business. (Tottori)

2) On selection of schools participating in the survey, survey period, and study and training.

In selecting schools to participate in survey, there should be a conference representing three viewpoints, the environmental agencies, school-related persons and members of the Committee of Experts. They should consider the weather and pollution conditions, locations in rela-

tion to the measuring centers, etc. (Fukui, Hiroshima, Fukuoka and Kagoshima).

A desire was expressed to simplify the method used for the survey and to enlarge the areas covered by the survey by multiplying the number of schools (Yamaguchi, Tokushima).

Considering the state of Ox generation and the weather, it was proposed that the survey be conducted during a two month period, July and August (Iwate, Ishikawa, Aichi, Niigata, Shizuoka and Gifu). However, there are many problems in conducting a survey in August during the summer vacation. Specific solutions to these problems require more study.

It is important to have uniform observation techniques and to raise the standards of technique in order to raise the accuracy of the survey. As a means to achieve this aim the following suggestions were made: (1) Hold well-planned research and training conference in each bloc prior to the begining of the survey. (2) Strengthen the guidance given at the sites by the members of the Committee of the Experts. A strong desire to follow these suggestion came from many prefectures (Miyagi, Fukui, Toyama, Tottori, Hyogo and Kagawa).

3) Managing the cultivation.

There is a need to move up the seeding date in colder areas. Also, a considerable increase in the amount of seeds planted is desired because germination is uneven (Miyagi). Methods of raising the young plants need more study. The following points require reconsideration. The growth of the plant is rapid and the plant become much taller than 2 m making it physically difficult to make the survey. Because the growth of side vines is pinched off, the growth of the main vine is vigorous with big and thick

leaves. Concern was expressed if those big thick leaves lose some of their sensitivity to Ox. (Aichi, Gifu)

Specific proposals have been made to maintain the sensitivity of young plants. It has been suggested that for observations from the last part of July to the last part of August, the seeds should be planted in the first part of June (Kochi). And for observations after August, the seeds should be planted in mid-July (Yamaguchi). Uniform standards should be set for the amount of moisture, soil conditions, growing conditions, fertilizing and cultivation. These are desired in order to have uniform sensitivity (Niigata).

An opinion wondering whether Scarlet O'Hara was too sensitive or not was expressed (Ehime).

Introduction of varieties other than Scarlet O'Hara to promote practical use of the indicator plant was requested (Aichi).

4) Environmental data.

The data needed for analysis of the survey of damage should be pointed out specificly in advance (Iwate). Because there are times when the calculation period of the Ox dose does not agree with the actual appearance of Ox, it has been proposed that the period should be extended to 10 hours, 9:00 A.M. - 6:00 P.M., instead of 9:00 A.M. - 4:00 P.M. (Fukui).